In this Issue FLYING BOMBERS ACROSS THE ATLANTIC

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AVIATION

The Oldest American Aeronautical Magazine

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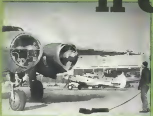
"it Couldn't be Done"



In Rapidly Increasing Numbers, Martin is turning out these [illegible] types of airplanes Martin B-26 medium bombers for the U. S. Army, Martin PBM patrol bombers for the U. S. Navy, and Martin 187 medium bombers for Britain.

The American aircraft industry has "buckled right in" and is doing the impossible

From a scant 43,000 men in the summer of 1939, it now employs 122,000 men and in a few months will employ 267,000 men From 13,700,000 square feet it is expanding to 28,600,000 square feet—an increase of 209%. That is a measure of the job being done

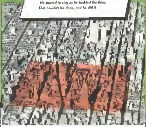
While plant construction surges on, new men are being taught new trades—leaders, foremen, supervisors and managers are being trained and advanced to increased responsibilities—AND—actual production of the world's most powerful air fleet increases month by month. This is America—tackling the job—and getting it done These pages tell the story of Martin's part of this job—a part that will make Martin the largest aircraft manufacturer in America From 1,263,000 square feet, Martin will increase to 3,717,163 square feet at Middle River—and other plants operated by the Company will bring the grand total to 5,192,725 square feet—411% plant increase, operating twenty four hours per day for the National Defense That is the job being done quickly and efficiently at Martin's

The Glenn L Martin Co, Baltimore, Md., U. S. A

"Somebody Said That It Couldn't Be Done"

As Edgar A. Guest Wrote It

Somebody said that it couldn't be done,
But he with a chuckle replied
That "maybe" it couldn't, but he would be one
Who wouldn't say so till he'd tried.
So he buckled right in with the trace of a grin
On his face If he worried he hid it.
He started to sing as he tackled the thing
That couldn't be done, and he did it



How Big Is 5,192,725 Square Feet? The floor space of these Martin Plants, if a one-story building, would cover an area in New York City extending north and south from 34th to 42nd Street, and east and west from 7th Avenue to Park Avenue That's over 119 acres!

Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

New Army Building, 1,184,000 [illegible] floor space in [illegible] by [illegible] summer. A [illegible] with machine shops [illegible] hammer building, employment [illegible] storage house and [illegible] house, etc Fronts on the Martin Airport, where four paved runways are being extended to [illegible] feet to accommodate the higher speeds and greater weights of modern bombers, which [illegible] being flown away daily.

New Omaha Plant, [illegible] Omaha [illegible] be completed by November. Here the Martin Company will build bombers [illegible] sub-assemblies and parts supplied by automotive and other non-aeronautical manufacturers Total floor space, 1,225,[illegible] square feet.

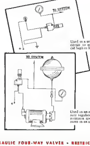
12,000 Workers will be at work at the Martin Plants at Baltimore alone by next spring. The Company is giving 'all-out' support to training in Maryland schools and colleges. Also, has devised tooling and production systems permitting employment of more less-skilled workers than has been possible before

Martin Main Plant, more than doubled in seven months Red shows new additions since last September—completed or rushing to completion In the photograph are Engineering Building, Administration Building, Personnel and Office Buildings Military Building, with addition completed, old and new Navy Buildings, Shops and Drop Hammer Building, 500-acre Martin Airport and Hangars Total floor space, 2,532,710 square feet.

FOR TOMORROW'S AIRPLANES

A NEW DEVELOPMENT
BY BENDIX OF BURBANK

HYDRAULIC-ELECTRIC SWITCH



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Used in an electric pressure regulating circuit to maintain specified pressures in an accumulator

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Aviation demands trained men and advances them rapidly, especially here in Southern California where there are over a billion dollars in unfilled aircraft orders on hand and where more than half of the United States' aircraft are manufactured. You can get in on the ground floor by training now. BUT you must choose the right school for your training.

In the very center and a very important part of Southern California's great aircraft industry is Curtiss Wright Tec. Established in 1929, in thirteen years this school has come to be recognized as the nation's leading institution for the training of Aeronautical Engineers and Master Mechanics. Mr. Donald Douglas, President of the great Douglas Aircraft Company, chose this school for his own son's training, which pointedly indicates the high standing this school has attained in the aircraft industry.

It is imperative that before you invest in a course of career training you determine what the returns will be on your investment . . . for your choice of a school in which to take your training will determine how much money you will make all the rest of your life.

Curtiss-Wright Tec's career training is carefully designed to do just one thing:—TO MAKE MONEY FOR YOU, so upon graduation you can be independent and self-supporting for life. Our thousands of successful graduates have proven that Curtiss Wright Tec training gets results and always pays, since it trained them in advance for the highest position they could ever expect to occupy. It can do the same for you.

This school has never guaranteed positions for its graduates, but practically every graduate has obtained immediate employment and is advancing rapidly. The demand for our graduates far exceeds the supply, and we honestly believe that every student who enrolls here will be able to obtain, with our assistance, immediate employment upon graduation.

WARNING!—"Don't miss the boat." The greatest opportunity in your lifetime exists today! There never was such an opportunity in aviation for you; there may never be another. BE THE MASTER OF YOUR DESTINY. Send in your enrollment before you "miss the boat."

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"CONTACT" Has Become A Word For Engineers!

"Contact" used to be the word that got you into the air. It isn't so important to the takeoff any more. Compressed air and electricity chased it off the hangar apron, back behind that door marked "Engineering". And when an engineer says "Contact", he's talking about *keeping* the ship in the air.

He's talking about the contact between balls and races in your ship's ball bearings. It's *that* contact which determines whether your engine and flight controls stay sensitive, friction free, and maintenance free, or develop the looseness that comes when wear creeps in.

Even if other things were equal (which they're not) the ball and race contact of a Fafnir Ball Bearing would still make an interesting story. The shadowgraph at the left shows why, with a magnification of 12 diameters. See how the precision ground ball of the Fafnir bearing fits the deep-groove, precision ground race. Contacts it, not at just one point, but across a wide area. That is why, in careful tests, the Fafnir shows a Unit Compressive Stress of 638,000# maximum, per square inch, when other ball bearings show unit loads up to 901,000# with the same radial load of 885 pounds!

You don't have to be an engineer to understand that the wear in a ball bearing is directly proportional to the amount of pressure the balls exert on the races. The smaller the contact area, the greater the pressure. But if you are an engineer, these facts should prompt you to do as hundreds of others are doing—letter "Fafnir" right on your sketches. The Fafnir Bearing Company, Aircraft Division, New Britain, Conn.

FAFNIR
Ball Bearings

FOR AIRCRAFT ENGINES AND CONTROLS

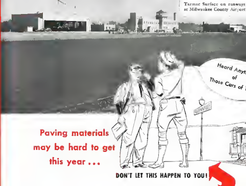
FROM THE KOPPERS LIBRARY OF TECHNICAL INFORMATION

ECONOMICAL METHODS OF TAR SURFACING FOR RUNWAYS, PARKING AREAS

WHY PRESSURE TREATED TIMBER EFFECTS SAVINGS IN INSTALLATION OF PERMANENT CONSTRUCTION

HOW TO BUILD ROOFS THAT HAVE A CLASS A RATING FOR FIRE RESISTANCE

HOW TO PROTECT CONCRETE AND MASONRY FROM THE DETERIORATING EFFECTS OF WATER



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AVIATION

Established 1916

OLDEST AMERICAN AERONAUTICAL MAGAZINE

This month sees more new aircraft and engine plants in operation than ever before. Above is the Wright engine factory at Cincinnati which began turning out engines last month. Other new production units are described in this issue.

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Bombers Over the North Atlantic

» IT IS IRONICAL that, on last Armistice Day the first formation of bombers for Britain to be flown over the non-stop North Atlantic route arrived safely somewhere in the British Isles

It makes you wonder, a little about what we have been celebrating on Nov 11 for all these years Since this first transfer of equipment last fall these operations have become routine As far as we now know there have been no losses of planes or personnel on these frankly hazardous flights, without benefit of adequate radio meteorological or navigational equipment Some pilots have been lost on the return trip by boat And, contrary to some of the current lurid literature on the subjects these ferry trips have not been intercepted by German fighters If they were, the unfriendly North Atlantic weather could probably be depended upon to furnish fog or cloud cover for the bombers The success of the North Atlantic ferry is a high tribute to American airplanes engines, and equipment and to the pilots and crews who fly the ships across If you want the straight story of one of these men giving most of the technical facts and none of the fiction on the subject, turn to page *30*

» AFTER YOU HAVE READ Captain Smiths' interesting account of the greatest ferry job in aviation history, don't get the idea that the Atlantic is as quiet as Wall St on Sunday afternoon Remember that one of the great strategic mistakes of the present war was that neither combatant provided itself with enough long range bombers As soon as it was realized that wars might not be strictly local affairs, everybody started to scramble for airplanes of the flying fortress type Our Air Services and our manufacturers had foreseen the need for this type and had gambled some private and public money on the idea The gamble turned out to be one of the best investments ever made By now both the Germans and the British are in possession of airplanes of this type in reasonable numbers And by their use they can carry the war deeper into enemy territory This means more RAF activity over Germany and more German activity in the Atlantic Ocean

IT IS HIGHLY SIGNIFICANT that General H. H Arnold has gone to Europe for war talks with the British As Deputy Chief of Staff of the Army and as Chief of the Air Corps, his mission is of great importance He traveled via PAA's Dixie Clipper

From recent reports it appears that the Nazis have developed a new form of airsurface cooperation technique,—the long range bomber and the little, 23 man submarine We will hear more from this combination in the near future.

» MID - ATLANTIC WARFARE brings the battlefont a little closer and already we are beginning to hear such talk as maybe Hitler will send a few ships over to go through the motions of bombing New York just as a gesture." Most of this talk comes from jittery Long Islanders who don't know the facts Until Herr Hitler supercedes the Diety, he cannot reverse the simple facts that the prevailing winds are westerly. That means that we can always fly toward Europe with considerably less gasoline load than it requires to fly toward us This natural law, which has irritated more than one trans-Atlantic flyer and many an airline operator, is one for which we may well give thanks to our Creator

» BUT DON'T LET IT LULL YOU into another of those sweet dreams of security in which we Americans love to indulge It will always be an advantage for us but, as airplanes grow in size and range, the handicap will tend to diminish Already we are building planes capable of flying the Atlantic non-stop with substantial loads of passengers and mail Because of the great areas we must defend, we are pioneering in the development of flying equipment of great range. European designers are not sleeping meanwhile.

» WE CAN'T LEAVE THE WAR without a couple of observations on tactical lessons learned in recent operations First there was the highly effective use of torpedo planes in the recent British naval victory in the Mediterranean This type of airplane seems definitely to have proved its worth Second is the fact that the notorious Stuka-Panzer team has demonstrated that it can work effectively in mountainous country Apparently terrain constitutes no serious obstacle

» IT'S CHERRY BLOSSOM TIME in Washington but the procurement officers of the Army and Navy and the boys of the Aircraft Division of OPM haven't had much time to see the blooms All you hear in their offices is talk about new increments, more square feet, and more horsepower, and how they are going to get more of all of these But they are just beginning to reap some of the reward for their hard and sometimes discouraging work The reward is in terms of total monthly production figures March brought these figures for airplanes well over the 1,000-per-month rate The Army-Navy-British total of 1,074 hit our January prediction squarely on the nose Total production for all military and heavy commercial types was 1,216

» SEVERAL CEREMONIES marked airplane production milestones Stearman delivered trainer No 1000 to the Army and No 1001 to the Navy in mid-March. Dedication ceremonies were held Apr 7 for North American's $7 000,000, factory of 1,000,000 sq ft outside Dallas (See page 21) Wright Aeronautical struck a telling blow against the light alloy casting bottleneck with a brand new magnesium foundry at Fairlawn, N J., having a capacity of 20,000 lb of castings a day Pratt & Whitney pushed two hangars out of the way at Rentschler Field to make room for 500,000 sq ft of additional floor space bringing the total beyond 2,000,000 sq ft. Republic wound up one order for YP-43's and was well underway on a larger order for P-43 Interceptors Vultee put into action an additional 750,000 sq ft at Nashville, Bell leased 110,000 sq ft more at Buffalo, Northrop doubled its space to a total of 550 000 sq ft at Hawthorne, Calif

» WEEKEND BLACKOUTS in air defense plants are fading according to O P M's Sidney Hillman who reports that 88 percent of the production workers in the aviation industry are now working six days a week 12 percent are working five days, and two plants employing one-third of all aircraft workers are now working seven days a week.

"Maguire claims his flush-riveted, stressed-skin baby carriage will keep the entire factory busy after the war ends."

Side Slips

By Robert Osborn

» Scientists all over the world seem to have made remarkable progress in recent years in the development of synthetic and plastic materials, internal combustion engine fuel from corn, ladies' dresses from wood and those other garments worn by the fair sex made out of skim milk, rubber from chili con carne, and airplane body parts from breakfast food. It's getting to be a disgrace to build a chicken house out of wood, nails and roofing paper, if some plastics can be found to fill the same needs.

Not that we're ungrateful for the great work of these scientists and research laboratories y'unnerstand. In fact we'd like to suggest as their most valuable research project, as soon as they get around to it, an attempt to make ships, airplanes, tanks and guns

out of the great over-supply of "bottle necks" this country seems to have.

» We see by the papers that wild life conservationists have become concerned over the possibility that new bombing and gunnery ranges, and the pollution of streams and coastal waters by new arms factories might be harmful to fish, birds and wild animals. Accordingly Mr. Ickes has appointed a wild life expert to defend them against the Defense Program.

Naturally this action will greatly concern those who are vitally interested in the National Defense Program, so we suggest the appointment of a Defender of the Defense Program against

the Defenders of Wild Life. There's a real title, probably rating at least 21 guns from the first game warden encountered.

« Before the start of the current war we made some remarks in this space which we are now very happy to retract, with apologies. We read some time ago that the English women and girls were being trained as skilled workers in airplane plants so they could replace the men workers in the event of war. At that time we inquired if English pilots were going to feel confident in flying airplanes held together with hair pins and bits of chewing gum.

Now, considering the outstanding fighting and bombing planes being turned out by these same skilled feminine workers, our editorial hat is certainly off to them.

» On the other hand possibly we should make some reservations in the above, not being in full possession of the facts of the case. Maybe some clever English designers worked up a line of rivets and cotter keys which look like hair pins, wrenches which work like can openers and factory equipment which closely resembles sewing machines. In any case, however, results were accomplished; we must admit they have been excellent.

» Somebody, we think it was a fellow named Aesop, once wrote a fable about the bees. It seems that after long years of use some uppity young bees decided there must be something better than hexagonal wax cells for a honeycomb. So, they tried square sections, round, octagonal and many other shapes without success. Finally, after several generations of bees had experimented, they were very much up against it until some bright young bee hit on the idea of using hexagonal cells. These worked very well and he was hailed as an outstanding scientist and was showered with testimonial dinners, medals and honorary degrees.

All of which leads up to the fact that we're discovering that the pioneers in aviation knew a thing or two. We've gone back to wheel controls in the cockpit, catapults for aiding take-offs, tricycle landing gears, square wing tips, and mayhap we shall soon see airplanes with twin pusher propellers driven by bicycle chains. Just so we won't be overlooking anything, we hope the NACA has on its research program the Wright Brothers' warping wings, forward control surfaces, and the pilot lying flat on the lower wing of a biplane. However, even if it were a big improvement we'd be against having the passengers sit on simple canvas seats slung between two pieces of bamboo, as that might cause the elimination of the stewardess as a member of an airliner's crew.

NORTH ATLANTIC FERRY

By Capt. V. Edward Smith

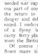
It is midnight and I am sitting in my "office" sucking on an oxygen tube and wondering why it takes the wing so long to come back up after each dip My First Officer is there at my side, also with a tube in his mouth, but he isn't sucking He is out cold due to the continued effect of high altitude My radio operator is in better shape but, since we are not permitted to use our radio equipment except in an extreme emergency, he spends most of his time staring out into the darkness

The night is as dark as the inside of your hat The glow from our running lights only 20 ft away is barely visible through a pelting rain We are being bounced around rather heavily by the storm after climbing to 18 000 ft in an effort to get rid of a load of ice More than 3 miles below us the North Atlantic is waiting to chalk us up on the scoreboard at the bottom of the sea, alongside the list of victims credited to the prowling submarines And it is those submarines that we are cheating tonight, for this is the first trans Atlantic ferry flight of bombers for Britain Ours is one plane in a formation of seven, all separated now, every man for himself in the storm

If the above paragraph seems on the dramatic side please forgive me To the men who made that first night formation flight, and succeeding 'mass" deliveries of bombers, it is a far cry from routine commercial flying Also I may claim some credit for not tossing a few Messerschmitts in for good measure, as most of the fiction writers have done Truth of the matter is that no trans-Atlantic ferry flight has yet been intercepted by Messerschmitts or any other type of enemy aircraft There are plenty of difficulties to be met on such a flight without worrying about enemy aircraft Although I made several ferry flights to Great Britain, the possibility of interception was always last on my list of worries

Many bombers have now been ferried across by the aerial route, and the stream of fly-away deliveries grows larger each month Although the actual number of planes flown to England is but a small fraction of most of the guess-work figures I see published, it is already considerable And to the best of my knowledge every plane has arrived safely at its destination Mass flights of bombers across the Atlantic, in mid-winter and over the great circle route, have now been demonstrated as a feasible delivery system It is faster and safer than shipping them by boat, and serves to release many tons of shipping for other needed war supplies The most dangerous part of our ferry work was always the return to Canada by boat This danger and delay is soon to be eliminated I understand, through operation of a flying boat service which will carry ferry plane pilots as passengers from the British Isles to Canada.

Of course the Atlantic had been flown many times before the bomber ferry system was started The list of ocean flights had grown so long prior to the present war that many people had come to speak disparagingly of the "duck pond" separating Europe and the North American continent The trip had been made by all sorts of people in all kinds of equipment Nevertheless, the Atlantic is still a formidable "duck pond", especially for mid-winter formation flights of landplanes navigating by dead reckoning, without benefit of radio, and under wartime restrictions Bear in mind that we have to fly a route that is in the general neighborhood of Greenland and Iceland, at night, and with very sketchy weather reporting Until last Armistice Day, when our squadron of seven Lockheed Hudsons arrived in Great Britain, the practicability of winter delivery flights of landplane bombers across the Atlantic was open to question Repeated successful delivery flights during the winter months have proved the feasibility of the operation


Captain Smith

Capt V Edward Smith is typical of most airline pilots in that his chief claim to fame is the fact that he has completed 21 years of commercial flying without incident" He engaged in the usual barnstorming work of the early 1920s, then operated a commercial flying school at Berkeley, Calif Here he trained a number of Chinese pilots and as a result of this experience eventually gravitated to commercial flying in China, first with Curtiss-Wright and then with Pan American Airways, China Division After eight years of airline flying in China, including a considerable part of the Japanese "campaign during which the technique of operating only in bad weather was developed Smith returned to this country for a visit and soon found himself flying bombers to Britain After several successful crossings of the Atlantic he is returning to China to resume airline work Prior to his North Atlantic flights Smith had made one crossing of the Pacific as a member of a Pan American Clipper crew

Detailed information on the bomber ferry operation has been unavailable to date due to war-time secrecy to which the crews are pledged Most of the accounts of such flights have been fictional or highly imaginative Since I am no longer connected with the ferry service, having retired to the ranks of airline pilots, it is possible for me to give a factual report on the ferry service This has been handled in such a way that no military information is revealed, even now Therefore the reader will understand why no description is given of the airport in Great Britain to which the ferry planes are being delivered, or the route by which it was approached

When the call went out late last summer for American pilots to ferry U S bombers to Britain, I had just arrived back in this country from a period of airline service in China After what I had been through in the Orient this North Atlantic scheme sounded

(Turn to page 132)

READY-MADE AIRPORTS

ONE ANSWER TO CONGESTION

If your community is short of airports, the author suggests that you put floats on your plane and fly it off the water

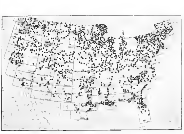
By Captain Robert S. Fogg
Chief, Seaplane Unit, C A.A.

THE thousands of rivers, lakes and harbors in this country offer a natural and logical solution to the airport shortage that faces us today Already 25 percent of the nation's flying fields have been closed to private pilots and commercial operators Each week the Army and Navy take over additional fields for purposes of national defense. In many communities the congestion at airports open to private fliers is becoming a real problem Water airports are one obvious solution

While there are 2,500 man-made airports in the United States, there are almost countless thousands of bodies of water from which seaplanes and flying boats can be flown It is amazing that commercial operators and private pilots faced with the dilemma of either giving up flying or finding a new airport, continue to overlook or ignore the obvious solution to their problem by equipping their landplanes with pontoons Then they could utilize nearby lakes, rivers and in many cases the very convenient downtown waterfronts instead of some remote, hot and dusty airport Here is a means of decentralizing flying and reducing the growing congestion at our major airports

Flying fields are often expensive both in first cost and in maintenance expense Existing water areas offer an immediate solution for flying facilities to many communities which for economic or topographical reasons might not be able to construct or maintain airports In many cases a water flying base would provide direct access to city centers and make possible the development of efficient short-haul feeder lines for both mail and passengers

Many operators who have Civilian Pilot Training students are being forced to find new bases from which to operate If they shift to a water base, the added expense of buying floats for their



These circles represent bodies of water where large flying boats could safely land and take off There are thousands of additional lakes and rivers which small seaplanes might use Map courtesy of Consolidated Aircraft Corporation

ships is balanced by the extra $50 per student paid by the government to seaplane operators In fresh water operation the maintenance of equipment is actually less than on gravel airports Salt water operation with its attendent corrosion difficulties can be combatted by proper treatment of the structure and the generous use of a hose following each days operation.

The advantages of student training on seaplanes are at both obvious and manifold On a busy airport with its traffic rules and signals, plus the necessity of making a complete circuit of the field for each landing, a student does well to average four landings and take-offs per given half-hour lesson Furthermore, his concentration and mental faculties must be divided between his manipulation of the controls and the danger of collision with other planes in the vicinity In a seaplane, instructor and student can go to some unused sector, make successive straight-away landings and take-offs entirely free from mental and physical encumbrances

Still more important, seaplane flying offers a means of training under the most pleasant and safest conditions known both to personnel and equipment, as in flying over water there is always an airport under you in case of sudden storms or forced landings The matter of time, particularly with business men and college students, is an important factor. To mention only one of the many examples seen by the writer is the case of a southern university where it is a 50 mile drive by automobile from the campus to the airport and return Allowing two hours for driving through traffic and another hour spent at the airport takes quite a sizable amount out of an eight-hour day This particular airport is quite proud of its long runways quoting their size in terms of *feet,* whereas five minutes from the campus is a beautiful protected water area measuring 10 *miles* by 100 *miles,* quite an airport it must be admitted, and free for the using

More and more people are now beginning to realize the great comfort, convenience and safety of water flying both for business and pleasure. It definitely has an appeal which attracts people who would not otherwise fly Whereas forced landings from motor failure are now admittedly rare, consider the comforting freedom of mind on a flight from New York to Miami, for instance, where the inland waterway provides a continuous landing strip within easy gliding distance all the way Or again take the 1500 mile flight from the Gulf of Mexico below New Orleans to the Canadian border at Minnesota You don't actually need any maps as you fly along with complete peace of mind at 300 feet above the Mississippi River

With all these apparent advantages then, what is the trouble—why isn't there more of this type of flying? There are several reasons, the natural and inherent fear of the unknown, the lack of an understanding of its basic requirements, such as how to properly hangar service and maintain a seaplane at its base, and where to stop for service along the chosen route Primarily it is the lack of proper facilities that has retarded the growth of water flying, wherein lies a viscious circle for "if there were more bases we would have more seaplanes and if there were more seaplanes we would have more bases" Obviously proper facilities bear a similar relationship to seaplanes as that of good roads to automobiles It is disconcerting, to say the least, to fly 500 miles and then have to spend several

(*Turn to page* 142)

Capt. Bob Fogg, shown here wielding a christening bottle at Bulah, Mich. has flown his seaplane to water bases all over the country With N.Y.A. cooperation, hundreds of seaplane ramps have been built and inaugurated under the supervision of the C.A.A. Seaplane Unit Seaplane flying will give a land pilot many new thrills

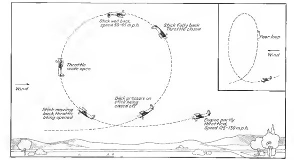


Fig. 1 A perfect loop In the square is a poor loop Note the difference in the wind direction.

Acrobatics Are Easy!

Part II

By Daniel J. Brimm, Jr.

This is a continuation of a series on acrobatics which started in the April issue. The author has been a test pilot, commercial operator and instructor since 1917 In addition to having written numerous books on aviation subjects, he is the co-author of CAA Bulletin No 23, "Civil Training Manual" and Bulletin No 5, "Flight Instructor's Manual." He is now on active duty as a Lieut Commander in the Navy

ALTHOUGH the loop is perhaps the easiest of all the acrobatic maneuvers it has always been considered by the general public as being thrilling and spectacular Perhaps the word "easiest" should be somewhat qualified, for though little difficulty is presented in making the ship climb into an inverted position and dive out of it, a well-shaped or precision loop such as that illustrated in Fig 1 calls for considerable skill and feel of the airplane

In the old days when we flew "Jennies," without benefit of parachutes, the usual method of a beginner in practicing the loop was to open wide the throttle of the dear old OX 5, dive until the interplane wires were screaming in protest brace his feet, haul back on the stick and hope for the best Sometimes he made it around the loop, sometimes he whip-stalled, and sometimes he stalled on his back and wallowed out of it Even so, a good pilot could perform a pretty fair loop with the under-powered and poorly maneuverable JN In fact, some were capable of looping these ships with the engine fully throttled Though, even with full power considerable altitude was always lost. Many of the modern sport ships will gain several hundred feet of altitude per loop

In the type of training ship about which this series is written it is desirable to dive until a speed of 125-130 m p h has been reached Some ships of the monoplane class, such as the low wing Fairchild trainer require somewhat more speed—140 to 145 m p h This dive is made with the throttle partly closed for two reasons First, with throttle open the r p m would go up well past the desirable limit Second, there would be no reserve power at the point where it is needed most Only one control, the elevator, is used in the actual performance of the loop The rudder and ailerons come into play only to keep the wings level and to maintain direction

The procedure is as follows Select a landmark, preferably a road which lies directly into the wind, point the ship along it and ease the stick ahead As the speed increases, gradually close the throttle so as to keep the r p m below the permissible maximum for horizontal flight. (As a matter of fact, if the cruising r p m are not exceeded, an entirely satisfactory loop may be performed) When the speed has reached the figure mentioned above, check to see that the wings are level and that the direction of flight is straight along the road. Bring the stick back smoothly and not too fast Also, be sure that it is brought straight back Since the force required is appreciable, there is a tendency to pull the stick slightly toward the right and produce a loop in which the flight path does not lie in one plane

As the nose passes the horizon on the way up, gradually ease the throttle ahead, at such a rate that it is fully open when the ship is in an approximately vertical climb As the pressure on the seat of your pants begins to lessen, come back more and more with the stick In a correct loop there is no tendency to hang on the belt Do not make the mistake, however, of pulling the stick all the way back before the peak of the loop has been reached There should be at least several inches of movement left for use on the way down

As the ship aproaches the vertical climb, you will naturally lose all sight of the ground. Heretofore you have been able to see the ground and the horizon throughout every maneuver and when it disappears and you have nothing but the sky before you, you will have a rather lost feeling However if you have followed instructions carefully, kept the ailerons in neutral and the rudder likewise, you will suddenly see the horizon again appearing over the top wing and parallel to it

As the nose passes the horizon on the way down, ease the throttle closed and gradually pull the stick the rest of the way back As you begin to approach level flight once more, you should feel a severe bump This is your own slipstream and if you do not feel it your loop has not been true You should finish pointing directly along the road in your original direction, and ease the stick ahead to neutral as level flight is resumed, opening the throttle to the cruising position

Now let's consider some of the things you might have done wrong If your wings are not parallel to the horizon when you first see it, you have let the stick move to one side or the other and you should make the proper correction immediately Since you are inverted this may be confusing, but simply remember that the controls function, *so far as you are concerned,* just as they always did If your left wing is nearer the horizon than the right, the stick should be moved to the left to correct the condition. Obviously it

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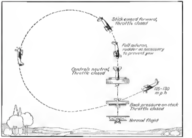

Fig. 2 A loop with a quarter-roll recovery

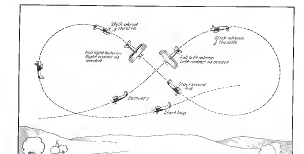

Fig. 3 The Cuban eight.

North American Aviation's new plant at Dallas

NORTH AMERICAN
Dedicates Dallas Plant

New factory completed in record time.

DRAMATIC proof that the American aircraft industry can do the job of providing weapons for our national defense needs was given by North American Aviation, Inc., of Texas, with dedication Apr 7 of the new million square foot factory at Hensley Field, Dallas. Superlatives must be used in any attempt to describe this plant, one of the first of our expended national defense program units to go into operation.

The new plant is now the world's largest completely air-conditioned and artificially lighted building. The most impressive demonstration was that, on the very day the plant was dedicated the first of the AT-6A advanced trainers were already completed and rolled out for delivery. And more than 1,000 employees were at work in the factory on the day of its formal opening, just a little more than four months after the first construction was started Nov. 23, 1940. This staff will be increased rapidly to a peak of approximately 12,000 making possible a production rate considerably in excess of ten trainers a day, AT-6A for the Army, and SNJ-3 for the Navy.

The amazing story of how North American has been able to start delivery of finished military airplanes from a spot which was virgin Texas prairie just four months before, goes back to the parent company in California, North American Aviation, Inc., and its production-minded president, J. H. "Dutch" Kindelberger.

Modest "Dutch" Kindelberger, a graduate of the Glenn L. Martin, and Douglas Aircraft Co. organizations, is always the first to disclaim any personal wizardry in the production field. Yet Kindelberger cannot escape the laurels which have been heaped on him by aviation experts. And, as "Dutch" would be the first to point out, that reputation has been established by the able corps of assistants with which he is surrounded. For Kindelberger's greatest genius is his ability to obtain men who have the "know how" of production. So many such men have contributed to the phenomenal rise of North American Aviation that it is not possible to credit them all.

Many aviation celebrities attended President Kindelberger's luncheon on dedication day, April 7th. Wm S Knudsen was given a standing ovation as he was introduced.

The parent plant of North American Aviation is just over five years old. Operations commenced in the Inglewood plant on Jan. 13, 1936, with a staff of about 300 employees, less than one third the number employed in the Texas plant at its dedication. So rapidly did the production curve skyrocket at the California plant that total personnel has expanded more than 3,000 percent in the five-year period. And this factory was proving its production mettle in 1940, before the fall of France and subsequent pressure for quantity output, by rolling as many as ten planes per day off the assembly line. Approximately 3,000 planes have now been built in the California plant, and operations have expanded to cover the field of trainers, pursuits, single-engine light bombers and twin-engine medium bombers, all of which are in production at the present time.

Out of the Inglewood organization has come the nucleus of trained personnel for the Dallas plant. About 50 top executives, department heads, and supervisors were sent to Dallas from California and around these men the staff was built. A three-way job was done from the start, with prompt establishment of administrative procedure, conduct of an extensive training school to develop qualified workers and lead men, and immediate initiation of manufacturing operations. All this was done in rented quarters while the factory was being erected, which explains how it is possible to deliver finished airplanes on the day the plant was dedicated. Equipment, jigs, fixtures and supplies were also sent to Texas from Inglewood, in order to get the new organization started.

To understand the relationship of the Dallas plant to the parent company it is easiest to consider it as a strictly production shop, rather than a complete factory. Most administrative, engineering, and tooling work is done in Inglewood and fed to Dallas. This procedure will be continued as a matter of policy, leaving to Dallas the one job of building airplanes with the tools provided. This same general procedure will be followed with the new Kansas City bomber assembly plant, now under construction. And the scheme can be further expanded if defense needs so require. It is this ability of our aircraft plants to divide and multiply, with almost incredible rapidity and efficiency which provides America with its stoutest defense armor.

In general layout and arrangement the Dallas plant approaches the ideal of production efficiency. The building is approximately square, all units being of one-story construction with slight exceptions. General arrangement is such as to provide a close approximation to uni-directional flow of all parts and materials from the time they come into the receiving department until the finished plane is wheeled out for its flight test. Receiving and storage departments extend completely across one side of the building while final assembly extends completely across the opposite side. In between are flow lines across the building from stockroom to final assembly of all sub units such as fuselage wing, engine, etc. Processing, manufacturing operations, and subassembly work all take place as nearly as possible in a series of straight-line movements across the plant. Arrangement of the plant and its equipment to make this possible is greatly facilitated by the fact that the building is completely air conditioned and artificially lighted. This makes it possible to place heat treat, chemical bath, grinding, and other operations which are normally segregated due to fumes, heat, etc., in their logical position with relation to production flow.

Provision of artificial fluorescent lighting, and air conditioning, also promotes efficiency in other ways. Reduction of employee fatigue and improvement in vision is said to give increases in individual output up to 33 percent. And substantial savings result from elimination of winter heat loss through window areas and ventilators.

Location of the plant at Dallas has strategic and economic benefits. The

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J. H. Kindelberger
Pres. & Managing Dir

J. L. Atwood
V. P. & Ass't General Manager

R. A. Lambeth
Treasurer

Ernest R. Breech
Chairman of the Board

Elmer J. Rivers
Factory Mgr Texas Pl

R. H. Rice
Chief Engineer

Kenneth P. Brown
Prod. Mgr Texas Plant

J. S. Smithson
Works Manager

C. E. Kindelberger
Ass't Sup't Texas Pl

Walter Sorsbee
Ass't Sup't Texas Pl

H. R. Raynes
Exec. Staff Ass't

Robert Dawe
Chief Inspector

R. L. Bula
Ass't to Pres.

Noble Shropshire
Contract Administrator

C. J. Ballard
Tech Consultant

Leland B. Taylor
Ind Relns Director

Plastics in Aircraft

This article, and the two that immediately follow, provide a basic understanding of the materials and uses of plastics in aviation today

By J. Earl Simonds, *Plastics Consultant*

IN the field of aircraft design the term "weight penalty" may be heard repeatedly Its continued usage appears amply justified because in the selection of materials for aircraft the weight of the finished part is usually of primary consideration This holds true regardless of the function of the part.

Experience has shown designers how to balance properly the weight of finished parts with the safety factors adopted for both transport and combat aircraft The proper balance, however is obtainable only by a thorough knowledge and evaluation of the properties of the materials and the relation between certain of the properties and the known or calculated stresses to which the part may be exposed under variable service conditions

The property of specific gravity or density of aircraft materials while of prime importance is not the sole factor considered in choosing materials For structural members a favorable ratio between specific gravity and certain other properties is more often the governing factor This is best illustrated by the very extensive present-day usage of duralumin rather than stainless steel in the all metal plane design Stainless steel is much stronger and heavier than duralumin, yet the ratio between certain physical properties and stress conditions of service favors duralumin and accounts for its widespread use At least two eminent authorities (8)*, (10), who have contributed much valuable data on plastics in aircraft appear to be in substantial agreement that the specific gravity and elastic modulus of materials, and the bulk or thickness of the structural members are of greatest importance and that the strength of materials is of secondary importance

Plastic materials are inherently light in weight, the specific gravity of the most extensively used types falling within the range of 1 05 to 1 50 While this property is always attractive to aircraft designers, other inherent properties peculiar to certain types of plastic materials have influenced the choice of materials used, as will be apparent in the following discussion of several widely varying applications of plastics in aircraft.

*See reference at end of article

Aircraft Propellers

With the trend toward more powerful engines, the weight of aircraft propellers has become a relatively vital problem, according to data supplied by Mr Fred E. Weick chief engineer of the Engineering & Research Corp. (5) The difficulty, which is well understood and dealt with in several papers listed at the end of this article (1), (2), (3), (4), can be attributed to the basic relationship between horsepower and propeller weight The required weight of the propeller increases in greater ratio than the engine power This relationship assumes that propellers are geometrically similar and of the same material. Obviously one approach to the obtainment of light weight propellers is to design for use of light weight materials One development along this line in recent years has resulted in a propeller blade constructed of laminated spruce, or similar light weight wood, protected by a tough weather proof plastic covering and terminating at the root in a cylindrical steel sleeve or ferrule which, if desired can be mounted in bearings in a controllable hub The original development was done by the Schwarz Co , in Germany, and the blades are manufactured in large quantities both in Germany and by Airscrews Ltd , in England The Engineering & Research Corp has the license here in the United States and has been carrying on experimental work here, aided by orders from the U S Army and Navy Air Services See Fig 1

Although the greatest advantage of these composite wood and plastic blades is probably their light weight, solid duralumin blades ordinarily being about 50 percent heavier, they have other attractive features also, such as their tendency to damp out vibrations, freedom from fatigue difficulties, and the ease and low cost with which new or experimental designs can be constructed This ease of construction of experimental models becomes of increasing interest as the propeller size increases

The Schwarz type of blade consists essentially of a main core of laminated spruce or other light weight wood, which merges into a root of impregnated and compressed wood (the root is called "compreg") The compreg is threaded and screwed into a steel ferrule which supports the blade in the hub The remainder of the blade is covered completely with a heavy coating of reinforced cellulose-acetate plastic sheet and the leading edge is armored with a flush strip of metal The plastic covering thus protects the wood core against climatic changes and warping, as well as against contact with abrasive particles rain and sea water

The compreg is made up of sheets of $\frac{1}{16}$ in thick hardwood veneer impregnated with a phenol-formaldehyde resin A stack of these impregnated sheets is then subjected to heat and high pressure where it is reduced to one-half the original thickness and the resin cured to a hard and infusible condition Thus the finished product becomes a compressed wood with the wood fibers impregnated and maintained in position by the cured resin The unit weight of the compreg is about double that of the original hard wood, the specific gravity being about 1.30

Slabs of laminated compreg are spliced and glued to spruce boards to form the blade block shown in Fig 2 The blade block is thus composed of laminated spruce for the greater part of its length, laminated compreg at the root end and at the scarfed region wherein the spruce gradually merges into the compreg After machining the compreg end, the blade is cut to form as shown in left-hand view of Fig 1 The blade on the right-hand is finished The cut-away view in Fig 3 shows the details of the complete blade assembly

Before leaving the subject of propellers it seems appropriate to mention a new plastic application which may be

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Fig 1. Erco propeller blades made by the Schwarz process The blade on the left has just been cut to form. At the right is the finished blade

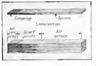


Fig. 2. The lamination shown above, indicates how the compreg is spliced and glued to the spruce board. The blade block, lower drawing, is made of a suitable number of laminations glued together

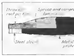


Fig 3 A cutaway view of the Erco blade showing how the spruce compreg and the steel sleeve fit together. Left

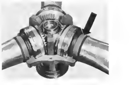


Fig 4. A Hamilton Standard propeller assembly showing the phenolic type of plastic blade shank chafing ring. These rings are molded from phenolic plastic material and mounted between the inner bearing race and the blade butt. Purpose of ring is to alleviate stress concentrations set up in blade shank due to contact with blade thrust races. Right

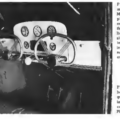


Fig 5. An Aeronca instrument board made from Monsanto polystyrene plastic. The primary considerations influencing this application were light weight and dimensional stability. Believed to be the first all plastic instrument panel, it is now standard on all Aeronca planes.

Fig. 6 A Martin B-26 bomber. The nose, top gun turret and the covering for the rear gunner's compartment are made of Plexiglas. Below

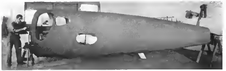


Fig. 7. The Duramold fuselage is molded without metal reinforcements of any kind. This structure is molded in two halves before final assembly.

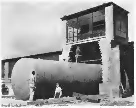


Fig. 8. The Duramold heat and pressure tank for molding reinforced aircraft structures. This pressure tank is in the process of being installed in the Grand Rapids, Mich., plant of the Haskelite Corp.

Fig. 9. The fuselage of the Timm trainer is made in two halves which are then pressed together in a precision mold and baked in the oven shown above. On the left is a wing section which will be baked at the same time

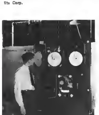


Fig. 10. Molded parts of the Summit airplane are placed in this pressure chamber. This shows the chamber and automatic temperature and pressure recording apparatus. Equipment is installed at the Bristol Aircraft Corp., Va.

Fig. 11. When the Summit HM-5 comes out of the mold it is as smooth as a table top. Former rings and stringers are attached in one process. The Summit is made by the "Vidal process" which is a method of molding under fluid pressure and heat of plastic impregnated sheets of veneer which have been placed on contoured and slotted wood forms

Molding Plastics

A discussion of molding methods being used in airplanes and accessories

By Robert Decat, *President, Airsealand Aircraft Research Co.*

The photographs on the two preceding pages will be of interest to readers of this article

THE family of plastics is apparently unlimited in its size, with each day bringing new members within its fold. When one stops to consider that such materials as rayon and neoprene, although coming under a different branch, are still members of the same family tree, an indication can be seen of how large the group is, even outside of the well-known plastics such as bakelite and celluloid. Then if any of these are reinforced with a cellulose fiber such as wood, paper, cloth, or with metal or cork, you obtain an infinity of reinforced plastics, each one with a different characteristic and strength.

Of all these possible materials, only a few have been chosen for use in aircraft structures. Many of the plastics had to be discarded because of their poor resistance to humidity, heat or acid, or for their dimensional changes on aging. However, such plastics as methyl-methacrylate, acetate, butyrate, or polystyrene, though not used today, might be used in the future because some new addition to them may be found to give them greater resistance.

As for the filler used, nearly everything seems to have been tried. The great difficulty is to get either a thorough impregnation of the product into the filler or a good bond between the filler and plastic or between the filler and more filler. Metal would have been a very good filler, and was even used in the late Micarta propeller blade in conjunction with canvas reinforcement on the leading edge, but the great difficulty is to get a thorough and controllable bond between the metal and the plastic. Linen, silk, or canvas, though used in industry, are not employed very much in aviation because they have no structural rigidity, and for molding they also require a steel mold, or at least a metal mold, which is heavy and very expensive. In Europe these materials are used as a filler and with them complete spars for airplanes have been molded that have a tensile strength rated around 45,000 lb. per sq. in.

Their use has been discontinued for the propeller, at least temporarily, because of a creeping that takes place of one section of the blade in relation to another. Of course this might be overcome any time, with progress developing so rapidly in that line.

Then comes wood, which thus far is the material most employed. There are a good many reasons for the use of wood. It can be worked easily and with fairly cheap tools. Also wood is a cheap material, its supply is still ample and wood workers are easy to find. The structural properties of wood cover a wide range, starting with balsa having a density of about 8 lb. per cu. ft. and going to lignum-vitae with a density up to 88 lb. per cu. ft. Above all, wood can be fastened easily, not only by nails or screws, but also by adhesives. Wood can be given a smooth finish and by impregnation, and sometimes compression, it can be given properties that make it capable of competing with metal. Wood is very seldom used in solid form because its strength depends on the direction of the grain. Also it is very difficult to get a piece of wood of uniform grain as it changes under conditions of moisture. It is for these reasons that plywood construction is mostly favored. Plywood minimizes the tendency of wood to shrink and swell, especially across the grain, but, as this shrinkage is not completely eliminated, all kinds of impregnations are utilized to get a constant material.

Three Ply Veneer Construction

To understand how this resin is applied let us visualize the construction of a 3-ply veneer: the first layer going lengthwise, the second at 90 deg. and the third parallel to the first. Between each of these veneers a film of resin named Tego, or a solution of water soluble or alcohol soluble plastic, or even urea or vinyl phenol formaldehyde, is applied. The whole is placed under a hydraulic press under a pressure of 100 to 200 lb. per sq. in., and heat up to 300 deg. F. is applied. This heat changes the structural formation of the resin it "polymerizes", meaning the molecules of resin combine together to give a product having a molecular weight which may be several times that of the parent substance and which give an entirely different property to the final resulting product.

Resins in Common Use

The three most popular resins now used because of their characteristic ease of workability and strength of gluing, are phenol formaldehyde, urea formaldehyde, and vinyl. While phenol is mostly used for its impregnation characteristic and its resistance to moisture, urea is now a great competitor because of its lower heat insofar as hot-setting is concerned. Vinyl which has just been introduced, is not yet widely used.

Any of these resins are available in water or alcohol soluble powder in a water solution as film, and they can be used either wet or dry. Though the setting is always better with heat, they all can be changed with the addition of a hardener into nearly cold or even completely cold setting, the only drawback being that if a hardener is added the resin sets after a few hours contact with the air, leaving very little time for any assembly. For this reason most manufacturers work with some kind of heating from 140 deg. up to 300 deg. F. with kiln or pressure tank. All these resins require some kind of filler which decreases their cost and their strength at the same time. When phenol is used as a bond for a panel, the panel automatically becomes much more water resistant, it can be boiled or dried, soaked in water for years, or buried in the soil. The wood will give before the bond. Urea will withstand all but the boiling test.

Vinyl, though now very much improved, especially insofar as water resistance is concerned, is extensively used in safety glass and is only now finding its way into aviation use.

There are several good reasons for hot setting the resin first; it is at least four or five times faster, very little or no moisture is added in the panel, and a thorough control of the moisture content can be made when curing. Also when the panel comes out of the mold it can be used immediately with no air or kiln drying.

You may ask why airplanes are not made of bakelite material like that used

(Turn to page 126)

Rudy Arnold

PLEXIGLAS EYES FOR OUR BOMBERS

PLEXIGLAS is one of the most useful plastics being used by the aviation industry today Because of the high speeds of our fighting airplanes and the great altitudes at which they fly, some kind of transparent covering is necessary for cockpits, and for the various gunners' and bombardiers' stations throughout the ship In the last war, combat pilots and the machine-gunners of bombers rode in the open Now the men in the combat crew must be enclosed from the elements and yet they must have large, transparent eyes' through which to see the enemy

In the field of synthetic resins the acrylics, to which Plexiglas belongs, are outstanding in colorless transparency, stability against weathering and aging, and resistance against chemicals These resins are derived by chemical synthesis from such raw materials as coal, petroleum, air and water In consistency they range from soft, tacky semi liquids to hard tough thermoplastic solids Variations are produced by controlling manufacturing conditions rather than by adding plasticizers No fillers are added to the acrylic plastics

In the Martin B-26, Plexiglas is also used for the tail gunner's enclosure, rear gunner's turret navigator's hatch and for the windows From the rear position the tail gunner can swing multiple machine guns in a wide angle

Left: The nose of a Martin B-26 bomber, showing the completed Plexiglas section, the forming of which is pictured and described on these two pages.

Workmen in the Rohm & Haas factory use templates for marking the size of Plexiglas sheets that are to be cut. This man is scribing around a wood and metal pattern The sheet will then go to the power saw for cutting to exact size

This is the same sheet that is shown in the two lower pictures on the opposite page The crimped edges need to be removed and this is done with a fast-moving head saw Unlike real glass this product of chemical research can be sawed, drilled and threaded with ordinary woodworking tools It will withstand a hard, direct blow without breaking but it is not bulletproof The camera has picked up some reflections due to the curve in the sheet but when cleaned and polished Plexiglas is even more transparent than the best plate glass While these original sheets are formed by the manufacturer in his own factory the Air Corps has found that maintenance and replacements are a relatively easy matter because the material is so easy to handle.

Sheets of Plexiglas are baked in an oven to 220 deg F. Then the pliable sheets are removed and draped over a cloth-covered form When a sheet cools it has assumed the contours of the form Because it is less than half the weight of glass and yet is strong and permanently transparent, Plexiglas is used for gun turrets, observation hatches side windows and cockpit enclosures in all types of fighting planes Photographs by Rohm & Haas

The next step is to clamp the Plexiglas firmly to the form. The wood clamping frame runs entirely around the form. While this section is cooling the same crew of workmen move on to another form to repeat the process A great deal of care is used to make sure that no specks of dirt get into the warm plastic, or that distortions are not present, as either would affect the accuracy of machine gunners or observers

Halves of the nose are cut to proper size and all necessary openings are finished The two halves are cemented together along the heavy line shown in this photograph An acrylic resin forms the bond. Edges of the Plexiglas are easily drilled so that hardware can be bolted to both the cut-out openings and to the entire periphery by which the nose is attached to the fuselage.

An important stage before final installation is cleaning, polishing and buffing. Here workmen go over the nose sections with cleaning cloths and power buffers Note that the wooden tables are grooved on top so that the Plexiglas sections are held firmly in place Table tops have a circular cutout so that men polishing the interior may stand comfortably at their work.

5 GUN TURRET

As defensive armament must be flexible, turret mounting of multiple guns is centering in bomber, patrol and military transport planes. Here a new design five gun battery is described

By Louis Bruchiss

The multi-gun turret mount herein described, and the theory on which it is based, was developed by the writer a few years ago in Europe, and patented there. Its construction and development were carried through to an adaptation of the variable fire pattern theory to anti-aircraft use, which was approved, after careful consideration, by one of the leading Scandinavian armament manufacturers. The aircraft armament picture has changed significantly in recent months, however, and this multi-gun turret should prove of definite interest to armament designers, inasmuch as it may be expected to be an improvement over existing types of aircraft fire.

ACTUALLY, multi-gun turrets are nothing new. Gun batteries up to the number of four machine guns have been variously mounted in turrets, with the entire battery operated either flexibly, or else (more commonly and efficiently) as an integral part of the turret, with the latter power driven by hydraulic or electric motors. But the guns of a multiple mount have the same fault, they all fire at a fixed point, discounting inherent dispersion and mounting difference. There is only one advantage in this concentration of fire, and that is fire power effectiveness. Where one bullet might hit, a concentration would enable several to score at approximately the same point, or near enough to possibly do some damage to a target. Fire power concentration is highly desirable in pilot gunnery, where the pilot can aim his fuselage and wing mounted armament directly at the target by maneuvering his own plane. The aircraft gunner, operating against a number of variable factors not under his control, has no such advantage. While following an enemy target with his turret guns, the aircraft gunner has no means of knowing at what moment his own pilot will change the course of his airplane, which would upset any aiming and firing he may be doing. The greatest obstacle in aircraft gunnery is the lack of time in which a target may be engaged and held. All other difficulties are minor compared with this one. The time element is so important that it has dictated airplane flexible armament design to an overwhelming extent, and the conditions are so changeable, and requirements have become so exacting, that present day practice may be obsolete tomorrow.

The Author

The best proof that none of the highly intricate sighting and aiming instruments available, operating in conjunction with guns in power driven turrets, can cope with the high speed airplane is the fact that tracer ammunition, and tracers only, form the principal source of target and fire control for the aircraft gunner. With airplanes traveling at more than 400 miles per hour in combat maneuvers, and with the gunner's own plane flying at comparative speeds in constantly changing positions, the gunner is faced with an increasingly perplexing problem.

Turret mounting of multiple guns is more and more being centered in multi-engined ships of the bomber, patrol and military transport types. All these types of ships are forced to arm themselves heavily, inasmuch as the bombers cannot carry fixed guns in fuselage or wings for defensive purposes. Defensive armament must always be flexible. The heavy long range bombers will therefore always have the disadvantage of less maneuverability and speed compared to enemy fighter craft. Their defensive equipment of armor plating and flexible gun installations is limited only by considerations of weight and space. Present day large scale bombing is being done at night, for only then is there reasonable safety from intercepter pursuit ships. With improved methods being devised to employ pursuit planes at night, large aircraft will shortly be susceptible to constant attack when over enemy territory. The loss of each large airplane with its personnel represents a blow to any power, and every possible means of improving defensive armament must therefore be considered and adopted, if at all feasible.

A gun battery for aircraft turret mounting must necessarily be restricted to machine guns, and when above two in number, to light machine guns of 30 caliber. On very large bombers, it might be possible to employ three 50 caliber machine guns in a single turret and even incorporate the variable fire pattern idea. Basically, the light machine guns have the advantage of a very high firing rate, combined with low weight of gun and ammunition, thus allowing fast and easy adjustment of the individual guns of the mount. Actually, full armament protection of large aircraft calls for gun positions of varying types, i.e., the multiple machine gun positions being bolstered by other positions carrying a single or twin 20 mm. cannon to cope with cannon-equipped enemy planes.

The technique of firing from an aircraft turret at airplane targets is simple enough, but varies in accordance with the weapons used, and the position of the turret. Primarily, it is only a question of waiting until an enemy plane comes within the effective range of the guns, rapidly calculating the lead to be taken and pressing the triggers or trigger control button. The white tracer streak will show whether the line of fire is correct, if incorrect, an adjustment may be attempted if there is still a frac-

(Turn to page 146)

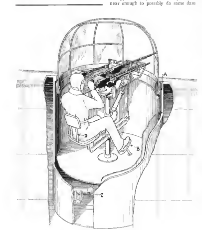


Fig. 1. The five gun turret with "A" the rollers for rotation, "B" foot control operating hydraulic control "C", and the seat "D" which tips with the elevation of the gun

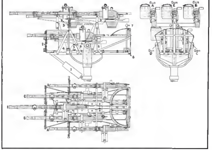


Fig. 2. Improved design of a 5-gun turret mount, incorporating variable fire pattern control. 1. Hydraulic cylinder for elevating and depressing gun mount; 2. control framework for lower guns "C" and "D"; 4. support for center gun "E"; 5. support for lower guns "C" and "D"; 6. support for upper guns "A" and "B"; 7. control lever handles for adjusting gun and battery; 8. control framework. Actual firing is done by pressing buttons mounted on the control hand grips which are connected to electric trigger firing devices.

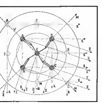


Fig. 4. Original conception of 5-gun battery using controlled dispersion system. The four outer guns could be spread out radially only from center gun "E".

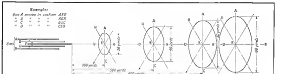


Fig. 3. Showing the fire pattern covered by each gun of the multi-gun turret at various ranges. When gun "A" is fixed anywhere in its sector "A, E, D", gun "C" to which "A" is automatically fixed, moves in sector "B, E, C" inversely.

PRODUCING 'CHUTES

Here is what is behind the scenes in building aviation's number one life saver.

One of the first steps in parachute production is cutting out the material for canopy and packs. The men above are using an electric cutter to cut many layers of cloth at one time to very carefully laid out patterns.

In sewing the canopies (below) the principle types of machines used are basters, two-needle machines, four-needle machines, and zig zag machines for making the necessary stitches. The work room must be kept clean so that no harm comes to the silk.

THE technique of parachute production has been developed by the Switlik company over a period of many years. This technique might be compared to the manufacturing of clothing, inasmuch as the majority of the steps necessary are done on sewing and stitching machines. Although the machines are similar, the quality of the work in the case of parachutes can be nothing less than the very best. Extremely accurate machines with experienced operators are necessary as it might almost be said a parachute is as strong as its weakest stitch. Every step must be inspected as there is no room for errors. The following photographs illustrate production methods.

In the picture below can be seen a line of stitching machines for producing pack harnesses. The production line moves from the front to the back and on the left are the completed belts being inspected and gathered for transportation to the assembly department. In this line linen webbing is cut to proper length and metal forgings are attached. The linen webbing has a break strength of 3,000 lb. and the forgings 5,000 lb.

The four-needle sewing machines (above) used in making the canopies makes two rows of stitches on the outside and two on the inside at one time. After this operation a careful inspection is made as this is an important step.

Over 50 sewing machines (right) are in constant use in producing the covers for the parachutes. This operation is carried out after the canvas has been cut to the correct size.

The steel frames (left) for the parachute packs are made on especially designed jigs. The operator at the lower right is bending the steel wire in the jig while the one at the left is soldering the necessary connections.

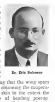
The completed chute is of an extremely clean design. A pilot is shown with a seat pack and seat pack harness. The cable around the center is attached to the ripcord and holds in the canopy cover which is on the bottom. When the ripcord is pulled this cover is forced open by a spring steel mechanism which throws out a pilot 'chute and automatically pulls out the main canopy insuring operation.

Silk is an elastic material. In order that all lines be exactly the same, the silk shroud lines are put under tension and marked (left) so that when the lines are cut they will all be of uniform length.

A Method for Solving

SHEAR LAG PROBLEMS

By Eric Reissner
Massachusetts Institute of Technology



Dr Eric Reissner

DESIGN experience has shown that the actual stresses in all-metal wings are sometimes appreciably higher than the calculation according to the customary beam formulas indicates. The reason for this can be roughly described by saying that the wing spars do not succeed in obtaining the cooperation of the metal skin to the extent the customary theory of bending presupposes. Since this efficiency-reducing effect would be absent if the skin material did not deform under the influence of shear, its designation as "shear lag effect" is appropriate.

The purpose of this paper is to present an analytical method for the determination of shear lag in monocoque construction, which is both simpler and more general than methods previously given. The simplification lies in the fact that the use of infinite trigonometric series is avoided and the method is more general insofar as it is applicable for tapered as well as untapered beams.

The problem and its solution may be explained by considering a typical structure such as a cantilever box-beam with constant doubly symmetric rectangular cross-section under the action of a given distribution of loads and with that of bending moments (Fig 1).

The customary theory assumes, without regard to shear lag, at every beam section a uniform chordwise distribution of bending stresses in the sheet and a linear distribution of side web stresses. This leads to the formula

$$\sigma_b = z\frac{M}{I} \tag{1}$$

so that the sheet stress would be given by

$$\sigma_{bs} = \frac{h}{2}\frac{M}{I}, \tag{2}$$

Now the spanwise variation of σ_{bs} would produce shear stresses in the sheet of magnitude

$$\tau_{bs} = -y\frac{d\sigma_{bs}}{dx}. \tag{3}$$

It is when one considers the deformation of the sheet under the influence of these stresses that the phenomenon of shear lag becomes understandable.

The bending stress σ_b, would produce an extension

$$\frac{\partial u}{\partial x} = \frac{\sigma_{bs}}{E} \tag{4}$$

The shear stress would produce a shear strain

$$\frac{\partial u}{\partial y} = \frac{\tau_{bs}}{G} = -\frac{y}{G}\frac{d\sigma_{bs}}{dx} \tag{5}$$

where in both formulas the quantity u stands for the spanwise displacement of the elements of the sheet.

Equation (4) would indicate that u is independent of the transverse coordinate y so that transverse sections of the sheet remain straight. Equation (5) would indicate that every originally straight transverse section would be warped into parabolic shape.

To remove this contradiction it is necessary to modify the simple expressions (2) and (3) for the stresses which are used in the customary theory and to find expressions in better agreement with what actually happens in the structure.

There is experimental evidence that the actual distribution of bending stresses in the sheet is such that it can be closely approximated by the following expression, which is the simplest possible modification of σ_{bs} as given by Eq (2),

$$\sigma_s = \sigma_{bs} - \left[m - 3\left(\frac{y}{w}\right)^2\right]\bar{\sigma} \tag{6}$$

In this formula σ_{bs} is defined as in (2) and $\bar{\sigma}$ is a correction term due to shear lag. The quantity m is defined as

$$m = \frac{1 + 3\,(I_{web}/I_{sheet})}{1 + (I_{web}/I_{sheet})} \tag{7}$$

and is determined by the condition that the stress $\bar{\sigma}$ does not give rise to an additional moment about the neutral axis of the beam.

An expression for the shear stress τ_s corresponding to σ_s is obtained by means of the equations of equilibrium for the elements of the sheet.

From

$$\frac{\partial\sigma_s}{\partial x} + \frac{\partial\tau_s}{\partial y} = 0 \tag{8}$$

there follows

$$\tau_s = -y\left\{\frac{d\sigma_{bs}}{dx} - \left[m - \left(\frac{y}{w}\right)^2\right]\frac{d\bar{\sigma}}{dx}\right\} \tag{9}$$

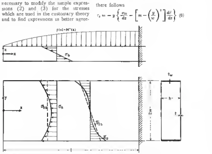


Fig 1 A cantilever box-beam with constant doubly symmetric cross-section under the action of a given distribution of loads and with that of bending moments.

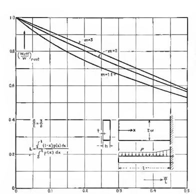


Fig 2. $\left(\frac{W_{eff}}{W}\right)_{root}$ for a beam of constant cross section when plotted against $\frac{W}{L}$ for various values of the stiffness parameter m (1.1, 2 and 3). (Left)

Though it is not possible to satisfy the stress-strain relations exactly with these expressions for σ_s and τ_s, it is possible to satisfy them much more nearly than in Eqs (4) and (5), by an appropriate choice of the function $\bar{\sigma}(x)$.

To determine $\bar{\sigma}$, the *least work method* is employed. Knowing that the exact solution of the stress problem makes the internal work W of the structure a minimum, one demands of $\bar{\sigma}$ that it makes W as small as possible.

The expression for the internal work has the form

$$W = \int_0^l\int_{-w}^{w} t_s\left(\frac{\sigma_s^2}{E} + \frac{\tau_s^2}{G}\right)dy\,dx + \frac{1}{E}\int_0^l\int_{-h/2}^{h/2} t_w\left(\frac{\sigma_s(w)\,z}{h/2}\right)^2 dz\,dx \tag{10}$$

where the first integral represents the work stored in the cover sheets and the second integral the work stored in the side webs. Eq (10) contains the assumption that the contribution of the transverse sheet normal stresses to the internal work can be neglected.

If one introduces into W Eqs (6) and (7) for the stresses and carries out the integration with respect to y and z one obtains W in form of a single integral

$$W = \int_0^l f\left(\sigma_{bs}, \bar{\sigma}, \frac{d\bar{\sigma}}{dx}\right)dx \tag{11}$$

where f is a simple quadratic function of its arguments.

To make W a minimum, for given σ_{bs}, by an appropriate choice of $\bar{\sigma}$ is a problem of the calculus of variations. Its solution is expressed in terms of a differential equation and boundary conditions for $\bar{\sigma}$.

If one defines two dimensionless parameters by

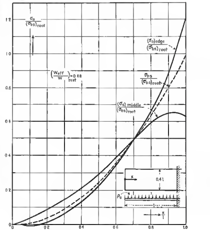
$$\lambda^2 = \frac{35m - 21}{35m^2 - 42m + 15}, k^2 = 6\lambda^2\frac{G}{E}\left(\frac{l}{w}\right)^2 \tag{12}$$

the equations which determine $\bar{\sigma}$ can be written in the form

$$\boxed{\begin{gathered}\frac{d^2\bar{\sigma}}{dx^2} - \frac{k^2}{l^2}\bar{\sigma} = \lambda^2\frac{d^2\sigma_{bs}}{dx^2}\\ (\bar{\sigma})_{x=0} = 0,\ \left(\frac{d\bar{\sigma}}{dx} - \lambda^2\frac{d\sigma_{bs}}{dx}\right)_{x=l} = 0\end{gathered}} \tag{13}$$

(Turn to page 140)

Fig 3. Stress pattern resulting from plotting equation 21—with values of m = 2, G/E = ⅜ and D/t = 0.2 (Below)



Where we stand in Aviation

In its relations with aviation, Goodyear occupies the same place it has long held in the automobile and motor truck industries – *that of a major supplier of parts.*

From the earliest days of the motorcar we have been manufacturers of tires, tubes, fan belts, radiator hose, motor mounts and numerous other rubber accessories – and of essential metal parts like rims designed out of our tire experience.

With equal faith in the future of aviation we began, *thirty years ago,* to apply our specialized knowledge of transport problems to the development of better products for all types of aircraft.

In close cooperation with the aviation industry we have perfected improved tires, tubes and other rubber needs – become large manufacturers of related accessories like wheels and brakes – acquired extensive facilities for handling alloy-metals used in aeronautical construction.

Continuing this policy, Goodyear today is erecting a great new factory devoted to the exclusive production of airplane subassemblies and parts.

This plant, to be operated by our subsidiary Goodyear Aircraft Corporation, will soon make available to the aviation industry our long engineering experience in fabricating metal parts for aircraft.

To overburdened manufacturers this will mean a dependable mass-production source of supply for wings, nacelles, floats, tail and other control surfaces such as we are now building on subcontract for Glenn L. Martin Company, Consolidated Aircraft Corporation, Curtiss-Wright Corporation and Grumman Engineering Aircraft Corporation.

These new facilities will round out Goodyear's position as the nation's largest manufacturer of aviation tires, tubes, wheels, brakes and more than 30 other closely related rubber and metal parts.

We believe that our many notable contributions to aviation, including among numerous others the Airwheel and Hydraulic Disc Brake, are the best guarantee of our ability to serve the aircraft industry advantageously in the future as a primary supplier of highest quality parts and accessories.

P. W. Litchfield

Chairman of the Board

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GOODYEAR

ON YOUR NEW SHIP SPECIFY GOODYEAR AIRPLANE TIRES, TUBES, WHEELS AND BRAKES

Detroit Gets New Airport

The story of how the Detroit Airport Committee overcame all obstacles in getting a much-needed new field is one that may help other communities finding themselves in need of a new airport.

Col. E. S. Evans

DETROIT is headed on its way toward getting an airport commensurate with that city's importance as a population and production center.

Plans for a new airport supplementing the existing municipal fields in the Detroit area are now so far advanced that only details remain to be ironed out before the start of construction.

This new airport has been so designed that it will have a Class Four rating, along with LaGuardia Field and the Cleveland airport—the only two airports in the country to hold this maximum rating of the Federal Government.

In the selection and acquisition of land for the new site, an Airport Committee headed by Col. Edward S. Evans, president of Evans Products Co., ran into so much more than a normal expectancy of political jockeying, attempted hold-ups by landowners, and opposition from communities bordering on the proposed site that a recounting of their experiences might prove of value to the other communities contemplating a similar expansion of their air facilities.

Detroit's major problem was overcrowding. The City Airport at Conner Rd. and Gratiot Ave. handles as many as 1,200 operations of private and transport planes a day. Built in 1930, it was then regarded as among the best municipal airports in the country. But it was built for lighter, slower craft, and for a far less rapidly developing industry than had evolved ten years later. Competent critics classed it among the most inadequate airports in any major city in America, and no provision had been made to allow for possible expansion.

Principal obstacle to expansion is a 330-ft. gas storage tank maintained by a local company on property adjacent to the City Airport. By a miracle of luck and good navigation, the tank has never yet been struck. But Captain Eddie Rickenbacker warned in an address in Detroit last spring that unless the tank were removed a pilot would eventually and unintentionally do the job himself. The major menace of the tank is that it sets up stiff and unpredictable cross-currents in a high wind. Partly as a result, the CAA won't permit landings with a cloud ceiling below 600 ft.

Far-sighted Associate Justice Frank Murphy of the United States Supreme Court, when Mayor of Detroit, realized the growing problem and named an Airport Committee, headed by L. P. Fisher, of the Fisher auto-body family, with Colonel Evans as vice chairman. During several succeeding city administrations this committee failed to get administration support. Fisher dropped out, and Colonel Evans became chairman.

Then last year youthful and air-minded Edward J. Jeffries, Jr., moved into the Mayor's chair determined to do something about the City Airport. He found in Colonel Evans the man he wanted—a straight-driving, enthusiastic and persuasive committee head who had the additional recommendation of a fine business and civic reputation. Despite the vast amount of his time and energies which are taken up with the direction of the affairs of his company, Evans has never turned a deaf ear to any worthy civic project.

Colonel Evans, it will be recalled, created headlines the world over in 1926 when he girded the globe at his own expense in specially chartered planes, ships and trains in 28 days (a record which stood until a few years ago) to prove the feasibility and possibilities of commercial aviation. He also managed the Sir Hubert Wilkins polar expedition in 1925, brought gliding to America, still awards the Edward S. Evans gliding trophy each year and has helped promote and direct nearly a dozen airplane manufacturing and operating companies which are now internationally famous.

Mayor Jeffries gave his committee practically a free hand, subject only to the limitations of an economy-minded administration. Colonel Evans immediately appointed subcommittees to investigate the feasibility of removing the gas storage tank, improving the present City Airport and finding a suitable location for another port.

Colonel Evans has consistently maintained that Detroit needs four airports: one for public transportation lines, another for schools and student training, a third for manufacturing and testing, and a fourth for private flyers. He has just as consistently maintained that Detroit, playing an increasingly important role in the production of aircraft parts

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Partial view of the present Detroit Municipal airport showing the hazardous 300-ft. gas tank adjoining the field. This tank has been an obstacle to pilots for years.

Drag of Riveted Wings

With so much emphasis placed on speed in present designs even rivet drag is an important factor. The following is the result of some NACA tests.

By Charles Peyton Autry, *Boeing Aircraft Company*

This discussion is intended to provide a practical insight of the excess power required in the drag of riveted metal wings with surface laps, being particular to small areas at high speeds. For certain types of wing surface construction and disposition the excess power required is of such an amount that this construction is highly unsatisfactory. Charts for a range of wing areas Reynold's Numbers and rivet dispositions are plotted to extend a means of estimating the drag in terms of the power increments. These power values have been plotted with the inclusion of an 85 propulsive efficiency.

THE NACA tests conducted by Hood[1] on wing surface irregularities included the effects of rivet heads and surface laps on wing drag. These tests were principally on an NACA 23012[2] airfoil of 5 ft. chord. The drag coefficient increments of the tests were employed in the power formula forming the curves as shown in Figs. 2, 3 and 4.

The rivets and laps considered herein are those shown in Fig. 1. The rivets are of $\frac{3}{16}$ in. shank dia. The increments are based on these rivets for a 5-ft. chord. The tests also consisted of runs on a like airfoil and rivet arrangement, of which the chord was 2 ft. and rivets were two-fifths the size of the $\frac{3}{16}$ in. rivets, drag coefficients of the two airfoils being increased by practically equal amounts at equal Reynold's Numbers, although the Mach numbers were considerably apart. The tests are thereby applicable on the basis of Reynold's Numbers alone.

Chordwise locations of the rivet rows and laps, in these tests, were as given further for the power charts herein.

Spanwise pitch of the rivets for the following power curves is .0125 of the chord or $\frac{3}{4}$ in. for the 5-ft. chord. The tests showed that rivet drag reduction was negligible up to the point of doubling the $\frac{3}{4}$ in. pitch with the forward rivet row at .04 of the chord from the leading edge. This was probably due to disturbance of the boundary layer, the drag increments being only slightly reduced by the increase in rivet pitch. With the forward row at .28 of the chord from the leading edge the rivet drag varied proportionately to the number of rivets as the pitch varied.

The tests also included the effect of various positions of the forward rows of rivets on the drag increments. Sheet thickness of laps as dealt with herein was .018 in. Drag increments as applied were taken at values when $C_L = .15$.

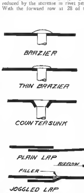


Fig. 1. Illustration of several types of rivets and joints used in fastening sheet metal for aircraft.

Power Increments of Two Wing Types at 400 m.p.h.

Fig. 2 and Fig. 3 present the values of these wings, Fig. 2 being with brazier-head rivets and plain laps. Fig. 3 gives the values for countersunk rivets and joggled laps with the bend fissure of the after sheet filled with a smooth surface filler. This lap is assumed to be representative of a lap having no drag, or that the lap drag has been successfully eliminated. The joggled laps at the plain lap positions without a filler in the after sheet bend fissure has a zero drag increment at an R of 7,000,000 and its maximum increment at an R of 13,000,000. Such a wing of 175 sq. ft. at 400 m.p.h. would produce a power increment of 45 at an R of 13,000,000. The drag under consideration in this wing is then due to countersunk rivets, which is caused by an indention around the rivet head, in the sheet, the result of punching. Fig. 2 is not typical of a wing of excessive drag increment, probably being as low as any average wing having plain laps and brazier rivets, with the exception of any rearward difference of position of the forward rivet rows and laps or effective rivet pitch increase that might be made. Sheets conformed fairly close to profile without any excessive or needless variations.

The rivets are in 13 rows on each surface of the airfoil. The plain laps are 6 in number on each surface. The

number or position of the joggled-filled laps has no bearing on the results, since they are assumed to offer no drag. The position of rivet rows on each surface of each wing are at .04, .08, .12, .20, .28, .36, .44, .52, .60, .68, .76, .84 and .92 of the chord from the leading edge. The position of the plain lap centers of each surface are .08, .20, .36, .52, .68, and .84 of the chord from the leading edge.

The charts of Fig. 1 and Fig. 2 are for various Reynold's Numbers which will give usable power values for the range of wing areas given, the 400 m.p.h. speed, average chords for the areas given and an average value of $\frac{\rho}{\mu}$[3].

The drag coefficient increment curves[1] of the tests plotted against Reynold's Numbers were extended from the maximum of 18,000,000 to 20,000,000 to include the increment for the latter value.

In accordance with the power charts Fig. 1 and Fig. 2, a wing with brazier-head rivets and plain aft-facing laps of the number and disposition given, the power increment may be reduced to about 22 percent by the use of countersunk rivets and the joggled-filled lap or its equivalent.

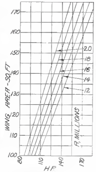


Fig. 1. Illustration of several types of rivets and joints used in fastening sheet metal for aircraft.

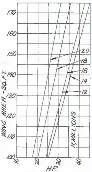


Fig. 2. Curves of horsepower plotted against wing area for 80 to 170 hp range for various Reynold's Numbers.

Effect of Forward Rivets on Power Increment

Fig. 4 is illustrative of the power increments for a wing of 200 sq.ft. at 200 m.p.h., with three types of rivets. The abscissas of the chart is the most forward row of rivets. Rows aft of the first row are at the positions previously stated with the exception of the rows forward of the position in question, which are non-existent. The joggled-filled lap or its equivalent is assumed. Rivets forward of the smooth wing boundary layer transition point cause this point to move forward resulting in an increase of the turbulent boundary layer extension and a corresponding decrease in the laminar layer. Lapped joint drag varied similar to that of rivets. In Fig. 4 the rivets forward of the .30 chord point constitute about 75 percent of the total power value when the forward rivet row is at the .04 chord point.

Reduction of the power increment by increasing the spanwise pitch of the rivets forward of the smooth wing transition point may not be appreciably accomplished unless the pitch is of some marginal consequence above .025 of the chord, as previously stated from the referred tests.

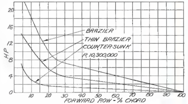


Fig. 4. The curves are for various types of rivets at a constant Reynold's Number of 10,300,000.

Conclusions

A typical high-speed single-engine pursuit airplane incorporating the types or rivets and laps of Fig. 2 would be required to yield as much as 20 percent of its total power to the rivet and lap drag of the wing. This could be reduced to about 4 percent or less by the use of joggled filled laps and countersunk rivets and elimination of rivets forward of the .30 chord point would further reduce the power increment to about 1 percent or less. The ultimate desired at high speeds would be complete elimination of rivet and lap protrusions or indentions. Preformed or smooth leading edges up to the .30 chord point and any practicable amount above are of much value.

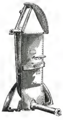
References

[1] Hood, Manley J., *The Effects of some Common Surface Irregularities on Wing Drag*, NACA Technical Note 695.

[2] Jacobs, Eastman N., and Pinkerton, Robert M., *Tests of NACA Airfoils in the Variable-Density Wind Tunnel. Series 230*, NACA Technical Note 567.

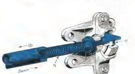
[3] Diehl, Walter S., *Engineering Aerodynamics*, The Ronald Press, 1936.

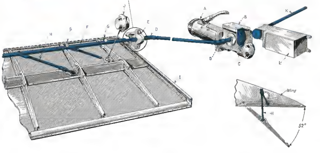
AVIATION SKETCH BOOK OF DESIGN DETAIL

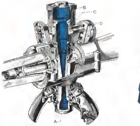


At the right is shown the main landing gear retracting strut used on the Vultee 12 Series airplanes. The strut is hinged through the tube at the top with the gear quadrant acting to retract the wheel which is attached to the strut at the bottom.

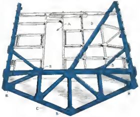
The flap on an early Model Lockheed Transport is shown below. In blue is shown the power mechanism which supplies power for raising and lowering the flap. "A" is an electric motor which is connected to the transmission at "B" thru the reduction gears "C". From this transmission and through the universal joints "D" power is supplied to the thrust bearing assembly "E". This unit is also shown enlarged, illustrating the thrust ball bearing "M" and the use of the screw "H". From the thrust bearing assembly the shaft assembly "F" can be moved longitudinally in either direction, being guided by rollers "G" depending upon whether the flap is to be raised or lowered. The link "H" shown in the large detailed drawing connects this shaft assembly with the flap "I". "J" is the flap position indicator for recording on the instrument panel and is connected to the left flap only. Similar power assembly for the right flap is connected through "K". "L" is a limit switch for restricting the amount of flap travel.



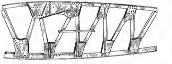




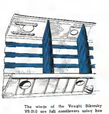
Above is shown a cutaway section of the hub assembly and blade-end of the De Havilland controllable pitch propeller. This propeller is made by De Havilland under licence from the Hamilton Propeller Standard Division of the United Aircraft Corporation. The operating mechanism is shown in the low pitch position for take-off and climb. Oil from the engine lubricating system enters the rear of the proper assembly "A" and follows the path shown in blue through "C" into the cylinder "B" which forces the cylinder outwards actuating the blades and holding them in low pitch. When the oil pressure is released the counterweights "D" are left free to bring this cylinder back in towards the hub and the blades then take the position of maximum pitch.



Shown above is one of the main fuselage bulkheads of the Boeing 314 Clipper. "A" is the opening for the passageway extending throughout the length of the ship. "B" are gusset blades which are riveted to the H—section spars. "C" is a typical fitting to which the longitudinal stringers are attached. "D" is one of the main spars of this bulkhead which takes a great deal of the load from the bottom hull of the ship when landing. Shown in blue are the parts of this bulkhead designed for taking most of the load.

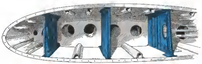


Shown above is a typical built up rib as used in the Boeing 314 Clipper. The cross members are U sections with channels being used for the top and bottom of the rib.

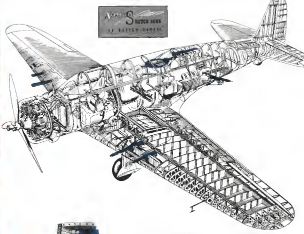


The wings of the Vought Sikorsky VS-310 are full cantilevers using box beam construction. Shown in blue are the interbeam ribs of the box beam construction of the stringers which are attached at regular intervals along the top and bottom. The front beam is located at 17% of the chord and the rear beam at 47%. This with an upper and lower metal skin form the boundaries of a torque box which carries all flight and bending loads. The front and rear beams are made of extruded aluminum alloy flanges machined to final shaping to which is riveted a plate girder rib with vertical stiffeners. Each flange of the beam is made up of a single extrusion and there are no laps or laminations in which corrosion can start. Interbeam ribs are suitably located to give the structure ample strength. The upper and lower skin assemblies consist of hat section stiffeners running spanwise, resistance welded to the skin to give the surface high rigidity and strength.

Below is shown the end view of the outer wing panel of the Vought V 143. Shown in blue are the three spars used in this wing construction. The wing is of monocoque construction built in three sections. Thus having a center section and two outer panels. The outer wing panels are attached to the center section of the wing by a series of ¼" bolts through a continuous aluminum alloy flange. There are two webs used in the wing in addition to the three shown and all five of these carry the shear loads between upper and lower surfaces of the wing. The surfaces themselves are suitably reinforced aluminum alloy stiffeners to enable them to carry the direct tension and pressure loads.



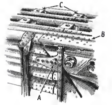
AVIATION'S SKETCH BOOK



The armament of the Vultee V 120 is shown in blue. This ship is an earlier design of this Vultee series but nevertheless is well equipped with machine guns. The rear observer-gunner can use either the top machine gun mounted on the swivel ring or lay on his stomach on the bottom of the ship and fire out through the tail

The attachment fitting for the Fleetwings Model XBT 12 stainless steel Trainer is shown at the left. Indicated in blue is a typical spot welded stainless steel rib. The main spar is attached to each of these ribs by four bolts, two of which can be seen, one on top and one on bottom. Along the upper and lower surface of the wings can be seen openings through which bolts are inserted to connect outer wing panels with the center section. A section of the landing gear is shown below

At the right is an enlarged drawing of the intersection of the upper surface of the wing "C" of the Fleetwing Trainer XBT 12 with the main front spar "A". This view is of the same section that is drawn from the underneath side shown in the drawing above. The landing gear attachment fitting is spot welded to the front of the main spar at "A" and above can be seen additional spot welds for connecting the corrugated reinforcement underneath the upper wing surface with a corrugated front spar at "B". "C" are attachment fittings for attaching the upper surface of the wing



Fleet's Trainer and Transport

Two Canadian models, an advanced trainer and a commercial air transport.

CANADA being the proving ground for much of RAF pilot personnel, production of training planes is to be expected, but when valuable plant space, time, men and materials are devoted to commercial transports in wartime it speaks for the importance with which air transport is regarded

Fleet Aircraft, Ltd., of Ft Erie, Ontario, offers two contrasting models in the 2-place Model 60 Advanced Trainer and the twin-engined Transport

The Trainer is an all-metal ship having semi-cantilever wings with external bracing. Powered by a 330 hp Jacobs engine, maximum speed is 181 m p h (sea level) and it cruises at 159 m p h. With a service ceiling of 16,000 ft, the trainer climbs at the rate of 1,150 ft per min and has a range of 910 mi With 80 gal auxiliary tank, range is 1,820 mi

Fuselage structure is semi-monocoque, and to facilitate maintenance it is constructed with a bolted joint at the second bulkhead aft of rear pilot's seat and a second bolted joint just forward of the horizontal tail plane These joints may be arranged so that their strength will exceed that of a normal riveted joint, permitting replacement of any one of three portions of fuselage which may be damaged.

Wings are in two sections, a right and a left, which are bolted together in the mid-section Each wing has a single beam of high strength aluminum alloy with laminated flanges of sufficient cross section to take all of the bending stress Metal ribs are riveted to main beam and extend aft to the flap and aileron false beams. All drag loads are taken in the leading edge skin

The engine is mounted by nickel steel bolts through rubber bushings held in steel fittings on engine mount ring Mount is a welded structure of 4130X steel tubing bolted to the fuselage at three points on face of fire wall

A unique system of oil temperature control consists of radiator unit built into the oil tank Upon leaving the tank on its way to the engine the oil passes through this heat exchanger which is supplied with hot or cold air under pressure through a selector valve controlled from the pilot's cockpit.

Cantilever type landing gear is provided consisting of individual shock absorbing legs mounted in main wing structure at the strut point just forward of the main beam These are readily detachable from the wing as a unit, being held in place by a bolt pattern at the lower wing surface and a single bolt at the upper surface Right and left members of the landing gear are identical and Interchangeable Sufficient strength is provided to accommodate the use of skis, and all-metal pontoons may be attached to main wing beam and leading edge by means of monocoque pedestals built integral with the floats

Specifications and performance data on Jacobs powered Fleet Advanced Trainer are

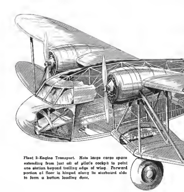
Gross Weight	3,900 lb.
Weight Empty	2,487 lb.
Useful Load	587 lb.
Power Loading	11 8 lb./hp
Wing Loading	19 5 lb /sq ft.
Max. Speed (S.L.)	181 m.p.h.
Cruising Speed (S.L.)	159 m.p h
Landing Speed (S.L.)	56 m.p.h
Rate of Climb (S.L.)	1,150 ft./min.
Service Ceiling	18 000 ft
Range (normal)	910 mi.
Range (With Aux. Tank)	1,820 mi

Fleet Model 50K Transport

Available in either landplane or seaplane models, the twin-engined Fleet Transport is a conventional biplane having no stagger and little overhang Powered by Jacobs engines, each 330 hp, top speed is 150 m p h, in the landplane model, or 148 m p h fitted with floats Cruising speed (landplane) is 132 m p h, landing speed 61 m p h, and take-off in still air under full load of 8,326 lb is possible in 14 sec Maximum rate of climb, 1,000 ft per min, and service ceiling, 15,000 ft With one engine operating the ceiling is 4,200 ft Extra fuel tanks of 70 gal capacity increase normal cruising range from 650 to 950 mi

Especially designed to accommodate all types of freight, the cargo floor is a single sheet of 17ST aluminum alloy, 064 in thick, supported by very closely spaced transverse beams These beams are riveted to lower edge of the side wall structure which carries the floor loads into the main fuselage structures through large aluminum alloy rivets

The Fleet Trainer is fitted with simple hinged flaps which result in comfortable landing performance.



Fleet 2-Engine Transport. Note large cargo space extending from just aft of pilot's cockpit to point one station beyond trailing edge of wing. Forward portion of floor is hinged along its starboard side to form a bottom loading door.

and bushings welded into the verticle fuselage members Cabin side wall lining is covered with aluminum alloy plate 064 in thick to a point about 12 in. above the floor, and from there to a point at the bottom of the cabin windows the walls are covered with corrugated aluminum alloy sheet 032 in thick

A distributed load of 2,000 lb can be carried on the central portion of the cabin floor at full flight and landing factors Forward and aft portions of the floor are designed to carry a distributed load of 1,000 lb each in the same manner. All door sills are constructed to sustain a load of 2,000 lb with a factor of two concentrated at the center of the sill

The stub wings, which form the main frame structure to a point outboard of engine nacelles and landing gear fittings, are of aluminum alloy 17ST Upper wing is built integral with the engine nacelle. The lower stub wings are of the same general type of construction having exceedingly heavy front and rear beams to sustain high bending loads imposed by floats or landing gear The shear bracing the lower stub wing is taken by top skin of the main fuel tank and is bolted into the wing structure on its four sides by closely spaced No. 12 steel bolts The main fuel tank is riveted to this upper surface with heat-treated rivets and the seam sealed with Thiokol compound Baffles in the main fuel tank are closely spaced, making the entire assembly extremely rigid

All engine controls are of special design having sliding members of the flexible cable or stiff wire operating through fiber-lined aluminum fairlead tubing without lubrication This is to eliminate the possibility of trouble due to lubricants congealing at extremely low temperatures Throttles are operated through 1/8 in flexible aircraft cables working in pairs. All other engine controls are operated by beryllium copper hard drawn, heat treated wire 072 in diameter sliding in fiber lined fairlead tubing

The fuel system is separate and complete for each engine and the two systems are only interconnected through the hand pump Cold weather starting is greatly facilitated by the practically constant flow of priming fuel The priming system is connected directly to pressure side of hand fuel pump, and by closing delivery valve to the fuel tanks and opening primer valves, a continuous flow of priming fuel may be delivered to the engine when hand pump is operated

The landing gear is a welded steel structure heat treated to 150,000 lb. per sq in. Main shock absorbing member is hinged to the front spar of lower wing stub Wheels or skis are mounted on the lower end of this member, and the fore and aft loads are taken by a single forked member running from the axle aft to the rear spar of lower wing stub Span, 45 ft , length, 36 ft , height, 13 ft 6 in , wgt empty, 4600 lb , useful load, 3726 lb

General Aircraft "Owlet" tricycle trainer. Notice the cantilever step for reaching the cockpit

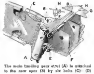
OWLET TRICYCLE TRAINER

The British have adopted this popular light plane for RAF instruction on tricycle landing gear ships and night flying.

By Paul H. Wilkinson *Consultant—Diesel Aviation*

TRICYCLE fighters and bombers require tricycle trainers. General Aircraft's "Owlet" described in this article is Great Britain's answer to the tricycle trainer problem. Not only is the "Owlet" used for day training but it also is used for night training. Furthermore, the safety characteristics of this all metal low-wing monoplane are such that it is eminently suitable for blind approach instruction work. Royal Air Force pilots and cadets now can gain experience on tricycle trainers ready to take over American-built tricycle warplanes.

General Aircraft contend that the early stages of training are accelerated greatly with tricycle trainers because cadets have more confidence in making landings and therefore solo sooner. Undoubtedly there is a good deal of truth in this British contention and the idea warrants serious consideration by those in charge of aircraft development in the United States. Here we are building vast quantities of tricycle fighters, bombers and transport planes but we have no military tricycle trainers. This condition should be remedied without delay so that our cadets can gain experience on inexpensive, low-powered tricycle trainers before graduating to expensive, high-powered tricycle warplanes.



The main landing gear strut (A) is attached to the rear spar (B) by six bolts (C). (D) is the rib to the trailing edge and (E) is the box and rib which is at the point where the outer wing panel is joined to the outer edge section.

The "Owlet" is not the first tricycle airplane to be developed by General Aircraft Ltd. A civil version known as the "Cygnet" has been in production for some time. While the "Cygnet" goes in more for comfort with side-by-side seating in a neatly streamlined cabin, the "Owlet" has tandem seating in open cockpits in the approved military manner. Both airplanes are powered with a 150 hp four-cylinder, in-line, air-cooled Cirrus Major built by the engine division of Blackburn Aircraft Ltd. (*See* AVIATION, *March 1941, p. 71*.)

The fuselage of the "Owlet" follows current military practice in that it is constructed in three sections to facilitate production. The nose section consists of an engine mount of welded chrome molybdenum steel tubing covered with an aluminum cowling which hinges upward to get at the engine. The center section consists of an open metal box-like structure with longerons at the corners and a removable wood deck. The seats and controls are mounted on two longitudinal bearers in this section in such a way that the seats can be lifted out if necessary. The plywood covering over the bearers also can be removed for inspecting the controls. The rear section of the fuselage consists of a monocoque structure with flanged sheet metal bulkheads and stressed aluminum skin.

The cantilever wing is built in three sections, the center section being integral with the center section of the fuselage. The outer sections of the wing have two I-section spars made of R.R.56 aluminum alloy riveted to sheet metal webs and stiffened on one side with riveted drawn sections. The ribs are of the sheet metal type flanged top and bottom and stiffened with riveted angle pieces. The wings taper in chord and thickness and are covered with sheet aluminum. The ailerons and the split trailing edge flaps also are

of all-metal construction with sheet aluminum covering.

The tail unit has twin rudders and fins and is of cantilever construction. Two metal spars are used for the stabilizer and it has a stressed metal covering. The rudders are fitted with mass balances similar to those used on the ailerons. A trimming tab is provided for the elevator.

The landing gear consists of three General Aircraft cantilever oleo-pneumatic legs with interchangeable Dunlop wheels. The two rear legs are anchored to the extremities of the rear spar of the center wing section and their wheels are equipped with Bendix brakes. The front leg is steerable and rotates in bearings attached to the fireproof bulkhead just behind the engine.

Dual control with column and rudder bar is provided. The rudder bar also operates the steerable nose wheel. The split trailing edge flaps are operated by an engine-driven vacuum pump. The two seats normally are of the bucket type for use with seat-pack parachutes but they can be fitted with cushions if required. The seats are adjustable fore and aft and are mounted on four ball supports. A baggage locker is located behind the rear seat under the fairing. Navigation lights and a landing light in the wing are standard equipment.

Two fuel tanks each containing 15½ U.S. gal of gasoline are carried on the "Owlet", one in each wing stub. The tanks feed by gravity to a streamlined sump located beneath the fuselage from which the fuel is drawn to the carburetor by means of an engine-driven pump. This system eliminates the possibility of air locks and tends to reduce fire hazard in the event of engine stoppage.

The Cirrus Major engine which powers the "Owlet" is a compact yet light weight power plant with a maximum output of 150 hp at 2,450 r.p.m. It drives a Fairey two bladed metal propeller 7 ft in diameter. When loaded with 31 U.S. gal of 70-octane gasoline and 3½ U.S. gal of lubricating oil, the "Owlet" has a flight range of 450 miles at a cruising speed of 110 m.p.h.

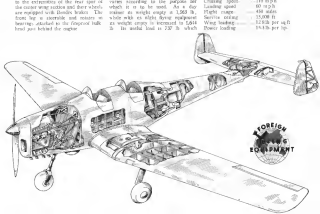
The weight empty of the "Owlet" varies according to the purpose for which it is to be used. As a day trainer its weight empty is 1,563 lb, while with its night flying equipment its weight empty is increased to 1,644 lb. Its useful load is 737 lb which includes an allowance of 340 lb for the crew and 40 lb for their parachutes. Thus, its normal gross weight is 2,300 lb but when it is used for aerobatics this has to be reduced to 2,000 lb.

A run of approximately 630 ft is required for take-off and a 50-ft obstacle can be cleared at a distance of 1,425 ft. from the point of departure. The initial climb is 770 ft per minute and the service ceiling is 15,000 ft. When landing with flaps and brakes the "Owlet" can be brought to a stop within 450 ft.

The civil version of the "Owlet" known as the "Cygnet" is of similar construction and in fact, the entire tail units of the two airplanes are interchangeable. The "Cygnet" has a weight empty of 1,475 lb and a useful load of 725 lb including 155 lb of baggage, making its gross weight 2,200 lb. Its maximum speed is 135 m.p.h., it cruises at 115 m.p.h. and it has a flight range of 450 miles. Its span is 34 ft 6 in, its length is 23 ft. 3 in, its height is 7 ft 0 in and its wing area is 179 sq ft. These dimensions are approximately the same for the "Owlet".

Specifications of "Owlet" Trainer (as day trainer)

Weight empty	1,563 lb
Useful load	737 lb
Gross weight	2,300 lb
Maximum speed	125 m.p.h.
Cruising speed	110 m.p.h.
Landing speed	60 m.p.h.
Flight range	450 miles
Service ceiling	15,000 ft
Wing loading	12.8 lb per sq ft
Power loading	15.3 lb per hp.



FOREIGN FLYING EQUIPMENT

The Blackburn Botha I

A British general purpose bomber used for land or marine operations in England's growing offensive against Germany

As a general purpose torpedo-bomber the Blackburn Botha I is doing its bit in carrying the war back to Hitler

Two Bristol "Perseus" Mark XA sleeve valve radials are carried in nacelles below the high wing The engines are fitted with leading edge exhaust collector rings and are enclosed in deep chord fairings with controllable cooling gills Three bladed, constant speed controllable pitch propellers are fitted Rear portions of the nacelles house the retractable landing gear and are detachable

Of all-metal construction, save for fabric covering on some control surfaces, the Botha carries a crew of four A peculiarity is that the nose of the ship is transparent plastic only on the starboard side, which is the bomb-aimer's position

The fuselage is of monocoque, flush riveted construction throughout A power operated multi-gun turret is situated to the rear of the main plane trailing edge Extending along the starboard side of the cabin, a gangway permits intercommunication between forward and rear positions

Composed of three principal sections, the center section of the wing houses the main fuel and oil tanks besides carrying the engine nacelles formed below the high wing The outer sections of the wings taper sharply toward the rounded tips and have a pronounced dihedral angle Balanced ailerons extend along a portion of the trailing edges of the outer sections, and hydraulically operated flaps along the trailing edge of the center section

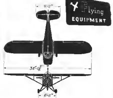
Both fin and tail surfaces are unbraced cantilevers of stressed skin metal construction Rudder and elevators are fabric covered and are balanced by a combination of inset hinge and horn balance Trimming tabs are fitted

The landing gear consists of separate retractable oleo pneumatic legs carried beneath the engine nacelles When the wheels are raised hydraulically doors mechanically operated close beneath the struts giving a smooth under surface to the nacelles Retraction is effected by hydraulic rams of the "nut cracker" type with rear struts Landing wheels are fitted with hydraulically operated brakes The tail wheel is mounted on an oleo-pneumatic shock absorber strut, the wheel having castor action with friction dampers

For marine work, equipment of the Botha includes a collapsible dinghy with inflation bottle, markers, floats, etc, in addition to complete radio equipment and electrical gear

Overall dimensions Span, 59 ft; length, 51 ft, 1½ in, height, 14 ft 7½ in

Oleo-pneumatic strut is of simple sturdy fork-type construction



Rearwin's Tandem Instrument Trainer

A NEW two-place tandem trainer Model 8135T, marks the re-entry by the Rearwin Company into the tandem field Designed expressly for instrument training, this model is a brand new version of the Rearwin Cloudster, the structure and aerodynamic features of which have been retained throughout. Also, the same ratios are used throughout the control system, which employs ball and needle bearings at all points

The trainer is actually divided into two separate cabins, one in front of the other Each compartment has its own door on the right hand side of the plane, permitting the entire inside width of the cabin, 43 inches, to be used as instrument space. A useful feature to the private operator who does not have a full-time seasonal schedule for instrument training is that this airplane may be used as a primary trainer simply by removing the rear instrument panel

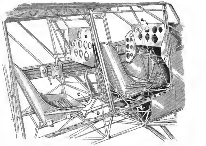
Particular attention has been paid to maintenance in the design of the trainer, especially in regard to the primary structure, flight controls, engine controls and engine installation A new style two-piece cowling is employed which hinges at the top and makes the entire engine compartment easily accessible Except for a small gill on either side of the firewall at the rear of the cowling, there is no intercowling of any kind The cowling is retained in a fore and aft direction by clamps which fit over lugs cast integral with the rocker box caps

A vacuum pump installation is provided to drive the dual sets of blind flying instruments, which include Sperry directional gyros and artificial horizons Primary flight instruments are mounted in shock mounted panels retained by Lord type fittings Provision has also been made for many additional instruments in their correct spaces

The first of this trainer series will be equipped with Lear transmitter and receiver, whip antenna, trailing antenna, DF loop, wind driven generator, battery, etc Intended as a trainer for the airlines, as well as with private operators, the instrument and general features of this airplane were developed through the cooperation of the Rearwin Engineering Department with Pan American Airways

Specifications and performance data of the Ken-Royce Rearwin trainer are

Wing Span	34 146	ft
Length Overall	21 5	ft.
Height Overall	7 33	ft.
Gross Weight	1900	lb
Weight Empty	1340	lb
Useful Load	560	lb
Wing Area (Inc Ailerons)	161 8	sq ft
Wing Loading	11 73	lb /sq ft
Power Loading	13 8	lb./hp
Maximum Speed	135	m p.h
Cruising Speed	120	m p.h
Landing Speed	50	m p h
Cruising Range	600	miles
Rate of Climb	860	ft /min
Service Ceiling	16,000	ft.



The trainer is divided into two separate cabins and with both doors on the right hand side the complete 43 inch width of the cabin can be used for the instrument panels "A" and "B". Dual controls are also installed at "C" and "D".

THE *Lockheed* LOG

LEADERSHIP IN ENGINEERING

TO LOCKHEED, the greatest engineering achievement is not to have built airplanes that have set the pace in aviation's development...but to have built airplanes that have stayed modern through years of progress.

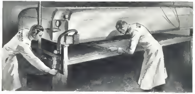
The Electra was Lockheed's first all-metal transport... one of the earliest two-engine airplanes to fly the airways. After it came the "12"...offering new economy and speed for private individuals and business corporations. Soon the "14" was developed...inaugurating wing slots and the effective Fowler Flap. And then Lockheed produced the Lodestar which again shattered all transcontinental speed records for airliners.

It is a tribute to Lockheed engineering that the basic design and inherent staunchness of these commercial transports was so adequate that several nations are now using adaptations of them for military purposes. The "212," with rotating and retractable gun turret and other armament, serves in the colonial defense of the East Indies...and the "Hudson Bomber," has an amazing record of dependability in the Battle of Britain.

It is a further tribute to Lockheed engineering that when the United States needed a fighting airplane of higher efficiency for defense, the "Lightning" (P 38) interceptor pursuit was designed. World wide attention has been focused on its outstanding records for speed and the new tactical effectiveness that is offered by its performance.

Lockheed's new process—Electrolytic Transfer—accurately reproduces master template layouts on sheet metal. It consists of two steps. (1) Scribing of drawings on specially coated metal sheets. (2) Electrolytic Transfer of drawings with all the pertaining detailed information to metal sheets from which templates are cut.

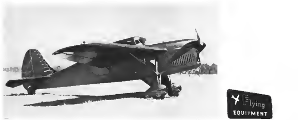
Rapidity of reproduction, absolute accuracy, low cost, and economy of operation are advantages gained by Electrolytic Transfer. The two metal plates are held in firm contact in this special press during the process—Any number of duplicates can be made. Time involved for making the complete reproduction is less than 5 minutes.



LOOK TO *Lockheed* FOR LEADERSHIP

LOCKHEED AIRCRAFT CORPORATION • BURBANK, CALIFORNIA, U.S.A.

Printed in U.S.A.



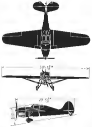
The Babcock Lightplane

THE Babcock Aircraft Corp. of De Land, Florida, has announced its two-place mid-wing cabin monoplane, the Babcock LC-13 A, which, with a landing speed of 42 m.p.h., should prove well adapted to small airports.

Powered with a Glenn L. Martin 120 hp. engine, the Babcock has a maximum speed of 150 m.p.h., and cruises at 135 m.p.h. It climbs at the rate of 1,400 ft. per minute and has a service ceiling of 20,000 ft. Weighing 980 lb., this plane carries a useful load of 620 lb., including fuel and oil which is sufficient to give a cruising range of 450 miles. Performance may be expected to be increased with installation of a six-cylinder Franklin rated at 130 hp. at 2,550 r.p.m., which the company is using in tests and with which equipment they contemplate an ATC.

Fuselage and tail group are of welded steel tube construction, wings are fabric covered with wood, strut braced, box spars, and semiweb trussed ribs. The entering edge, nose ribs and covering back to the front spar are aluminum.

One of the outstanding features of the Babcock is that the area of vision is greatly increased by four large windows in the roof of the cabin, affording a clear view above and to the rear.



Specifications

Performance

Maximum speed	150 m.p.h.
Cruising speed	135 m.p.h.
Landing speed	42 m.p.h.
Cruising range	450 miles
Rate of climb	1,400 ft. per min.
Service ceiling	20,000 ft.

Areas

Wing (including aileron)	135.44 sq.ft.
Aileron	14.90 sq.ft.
Stabilizer	12.72 sq.ft.
Elevator	10.00 sq.ft.
Rudder	5.26 sq.ft.
Fin	5.95 sq.ft.

Dimensions

Span	30 ft. $9\frac{3}{16}$ in.
Length	20 ft. $5\frac{3}{16}$ in.
Height	6 ft. $1\frac{1}{2}$ in.
Landing gear width	$68\frac{1}{2}$ in.

Weights

Gross	1,600 lb.
Empty	980 lb.
Fuel (Three tanks)	184 lb.
Oil	26 lb.
Baggage	70 lb.
Pilot	170 lb.
Passenger	170 lb.

Engine

Glenn L. Martin 333 in-line 120 hp. at 2,100 r.p.m.

Aviation In Transition

By Selig Altschul

ALL the returns for 1940 are in. The annual reports for the aircraft builders, in addition to being a complete documentation of the previous year's activities, also reflect the rapidly changing status of the industry.

A number of general conclusions are readily discernible from the information at hand. All reports comment upon the unprecedented increase in unfilled orders occasioning tremendous expansions in payrolls, plant equipment and other facilities. All this has meant a sudden ballooning of the industry's aggregate balance sheet. And here is a significant fact. The total assets of eight major aircraft companies—representing the bulk of the industry—totaled about $685 million as of December 31, 1940. Of this amount approximately $373 million, or 55 percent, represented advances received on sales contracts. Such cash advances, made by the government and other customers for the most part, are allocated for materials and labor costs going into new planes. Yet to be reflected to its fullest extent is the Government financial support for new plants and facilities.

Contract awards for all government financed plant expansions in all armament industries from July 1940 through February 1941 totaled $1,350,445,281. In addition, letters of intent covering plant facilities estimated to cost $244 million have been issued. The British government is financing plant additions to the extent of $171 million. Private capital provided only $393 million. All told, $2,158,000,000 is the overall cost of defense plant financing in the United States under government supervision as of the end of February. While no detailed breakdown as to industries is available, it is self-evident that the aircraft group has an important stake in this expansion program. One of the largest defense-plant contracts involved $57 million for the Wright Aeronautical Corporation.

Not only do these figures indicate the extent of plant additions yet to be made in the aircraft and other armament industries, but they can well dissipate certain fears entertained as to the post-war status of the aviation group.

The drastic deflation that followed the first World War is held up by many as the inevitable pattern that is bound to be duplicated at the termination of present hostilities. The fact remains, however, that the bulk of plant expansion in the 1917-18 period was almost completely financed by private capital which ultimately took it on the chin when the emergency was over. Expenditures for new plants in our present rearmament effort are, for the most part, being borne by the Government. In fact, only about 18 percent of these expenditures represent private capital. This is an important distinction and should carry particular weight as it pertains to the aircraft group. The large mid-west assembly plants will be entirely financed by the Government, with the aircraft companies hired to operate them on a fee basis. The Emergency Plant Facilities contract has had a wide adaptation in the aircraft industry. This plan permits the company involved to have its emergency construction amortized over a five year period at government expense. At the end of this period, the company has the option of acquiring the property or permitting the title to be assumed by the Government. Recently, the Defense Plant Corporation, an RFC subsidiary, has assumed the burden of financing plant expansions. Similar in many respects to the EPF contract arrangement, Defense Plant Corporation holds title to the plant during the five year period. The plant builder rents the facilities at $1 a year plus upkeep and taxes. Thus it can be seen that the tremendous aircraft expansion is not being assumed by private capital. In fact the industry may find itself in the favorable position of determining the extent of government financed plants it may decide to acquire based on the demands for aircraft that may exist in the post war period.

While it is true the aircraft industry will have many problems to contend with in the transition from a rearmament program to a peace-time economy, overexpansion of plant facilities by private capital should not be a matter of undue concern.

The equities of the major aircraft companies are in some cases selling at less than four times reported earnings. This is merely a reflection of the widely asked question: "Is aviation solely a war baby?" Under normal circumstances the old rule-of-thumb determination would be for the general run of stocks to sell at 10 times earnings, with growth equities entitled to sell at 20 times earnings. While it may appear difficult to reconcile prevailing conditions with this general rule, the answer is fairly simple. In 1936 and prior, investors were willing to pay a premium for the normal peace-time development of a company which could be expected to realize a normal profit on increased business. But these are no ordinary times. Another answer to the market anomaly pertaining to the aircrafts, may lie in the fact that capital—notoriously timid—virtually goes into hiding in wartime. With the emphasis upon "safety first," rising earning power tends to be capitalized at an abnormally

(Turn to page 144)

Barron's Stock Averages

	Air craft	Air Transport	50 Stocks
April 4 1941	36.55	21.52	72.0
March 28, 1941	36.12	20.66	72.0
March 21 1941	36.55	21.00	72.0
March 14 1941	36.58	21.50	72.0
March 19 1940	45.50	30.81	87.0

Profit Margins for Major Aircraft Builders for Year Ended December 31, 1940

	Sales (000)	Net Profit After All Taxes (000)	Profit Margin Before Taxes	Profit Margin After Taxes	Net Per Share (1940)	Net Per Share (1939)
Boeing	$19 391	$375	2.9%	1.9%	$0.34	(d) $4.55
Consolidated	9 350	1,401	26.2	15.1	2.30	1.79
Curtiss-Wright	138,720	15,747	24.4	11.4	(a) 1.81	(a) 0.39
Douglas*	60 911	10 832	22.0	17.8	18.05	4.81
Lockheed	44 937	3 166	11.5	7.1	3.17	4.04
Martin	30 664	5,425	27.7	17.7	4.94	3.75
North American	36 863	7,090	27.2	19.1	2.06	2.06
United Aircraft	127 447	13 140	26.4	10.3	4.94	3.53

* For Year Ended November 30, 1940
(a) On Common Stock
(d) Deficit

Aviation RADIO

Dialing the Air Waves with Don Fink

RCA Annnnnces 3-Way Aircraft Portable

A portable receiver, type AVR-102 which covers the beacon range from 150 to 400 kc as well as the broadcast band, is the latest addition to the RCA Manufacturing Company's line The receiver is a six tube job, intended for use with battery power supply (200 hours per refill), or 115-volt a c or d-c power. A tuned r-f stage and highly efficient antenna circuits make this portable considerably more sensitive than similar models previously announced. The speaker is protected by a metal grille. The price is $39 95 A filter may be installed in the receiver for simultaneous radio range reception of voice and beacon signals at $4 95

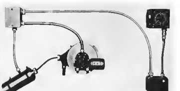
Lear Eqnips Panagra Fleet With ADF-8's

The Lear (Lear Avia, Dayton, Ohio) model AFD-8 direction finder and communication receiver, designed last year for military and airline use, has hit the jack-pot on the Pan American-Grace Line Airways ships. All of the Douglas airliners in this fleet are being equipped with two of these units, mounted at the radio-operator's position One 360° azimuth indicator for the automatic radio-compass is mounted in the pilots position, another at the equipment itself, in the radioman's compartment at the rear A selector switch permits either of the receivers to serve as radio direction finder so that bearings may be taken on two stations almost simultaneously without need of retuning Normally one receiver is used for direction finding while the other serves on any of the five communication bands provided, 195-405, 498-1195, 1190-2832 2800-6720 and 6400 15, 360 kc The latter two bands serve for communication only, the other three for communication or direction finding The radio compass is of the station-seeking automatic motor driven loop type

Automatic Antenna System By Air Associates

Two new developments relating to aircraft antennas have been released recently by the Radio Division of Air Associates, Inc of Bendix, N. J. A completely automatic reel-out and reel-in antenna system, under the type numbers AR12 and AR24, not only frees the pilot-operator of any responsibility for control of the antenna, but keeps him informed continuously of the length of the antenna in use. Type AR12 operates on 12 to 15 volt supply, whereas type AR24 is identical except the voltage range is 24 to 30 volts.

RCA 3-way portable radio, selling for $39.95 less batteries.



Air Associates' automatic reel-out and reel-in antenna system, type AR12 and AR24

Units of Lear's ADF-8 direction finder L to R remotely controlled multi-band receiver; 360 deg azimuth indicator; manual loop rotation crank; remote control unit H drive junction box; Learmatic navigator (optional) automatic station-seeking loop and nacelle

The antenna reel proper is mounted in a fully inclosed aluminum casting, which contains reduction gears and the synchronism mechanism for connection to the length indicator. A one-twentieth horsepower motor is mounted on the casting The reel accommodates 350 feet of stranded phosphor bronze antenna wire. The wire leaves the plane through a fairlead assembly which contains a switch actuated by the wire. When the wire is fully retracted the switch turns off the motor, and connects a green "in" signal light. A red "out" signal light is connected when the wire is partially unreeled A control box, mounted within reach of the

pilot contains these lamps and the control switches The synchronous length indicator is mounted near the control box but is a separate unit The drag on the wire fully unreeled, is about 6 pounds at normal cruising speed The entire assembly weighs nine pounds

An item of particular interest to the low-power field is a loading unit for use with a fixed antenna which combines the function of a loading coil and a support insulator Labelled type AR-6 this unit has a variable inductance range sufficient to load an antenna as short as 12 feet to the 3105 kc frequency The coil is mounted at the far end of the antenna, where it serves also as an insulator attached to the frame or tail assembly of the plane The coil is fitted with an adjustable slider by which the inductance may be varied to suit the installation The loading by extending the effective electrical length of the antenna brings the point of maximum current out further onto the exposed length of the antenna proper thus considerably increasing the radiation efficiency of the wire. The results are said to compare favorably with those obtained with trailing antennas of moderate length

Air Associates type AR-6 loading unit for use with a fixed antenna

E P Gertsch, new Chief Engineer of Air Associates Radio Division

The new chief engineer of the Radio Division of Air Associates is E. P Gertsch who for many years was associated with the aircraft radio division of the RCA Manufacturing Company serving as Section Engineer in charge of domestic aircraft transmitters in that company until his transfer to Air Associates early this year

Battery-Operated Transmitter-Receiver

A new type two-way, portable radio telephone unit has been introduced by the Electronic Specialty Co, Glendale, Calif, manufacturer of Ranger aircraft receivers Measuring 11½ in wide by 7 in high, the Ranger unit carries complete receiving and transmitting equipment dry-battery power pack and a four-inch loud speaker which is automatically cut in when the headphones are removed or when the unit is used at home or office to obtain weather reports Average transmitting range is claimed to be 10 miles, with operation over greater distances frequently reported

The transmitter is crystal-controlled on 3105 kc, and is put in operation with a push button control on the microphone Filament-type tubes are used, and a relay operated by the push button control cuts out the receiver filaments during the transmitting period.

Flexible Receiver New Western Electric Release

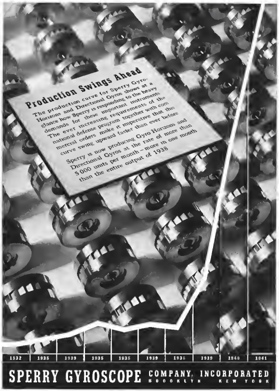
A new aircraft receiver, especially designed to offer high performance in installations where instrument panel space is at a premium, is the 33A recently announced by Western Electric Company, Kearny New Jersey The economy of pilot's view space is accomplished by restricting the circuits mounted on the instrument board to the antenna, r-f, and tuning circuits The intermediate frequency amplifiers, second detector, audio equipment and power supply are mounted together in a somewhat larger unit which may be placed anywhere within ten feet of the tuning unit

The r-f unit has provision for two crystal-controlled oscillator frequencies, and three continuously tunable bands covering 250-625 kc, 3900-7500 kc and 6750-12,200 kc The panel contains the tuning dial (with "write-in" spaces for logging the crystal frequencies) the volume control and on-off switch, band-switch, beat-frequency oscillator switch and phone jack The sensitivity is high, 5 microvolts input for 50 milliwatts output, average, power drain is 1.5 amperes at 24 volts (12 volt operation optional), and the maximum audio output 700 milliwatts, is high for a communications receiver The power supply is of the dynamotor type The amplifier circuits of the receiver are arranged for amplified interphone operation if desired The incoming signals and interphone conversation may be heard simultaneously by lowering the volume level The entire assembly with cables and two units, weighs 18 pounds 3 ounces

Airguide models TR-1 and TR-2 have the same panel

Airguide Transmitter-Receiver Features Compact Assembly

A compact transmitter-receiver combination occupying only 247 cubic inches of mounting space has recently been announced by Airguide, Inc, Islip, Long Island N. Y The dry-battery model, TR-1, with three-quarters of a watt transmitter output, weighs 15 pounds complete with batteries The dynamotor supply model, TR-2, has a power output of 12 watts, weighs 16½ pounds Each model comes in a case 7 by 5⅞ by 6⅞ inches with side panel mounting members for supporting the equipment directly from the instrument board of the ship The transmitter frequency range 2600 to 7000 kc, includes the harmonically related assignments 3105 and 6210 kc The receiver covers 200 to 400 kc and 550 to 1550 kc, employs four tubes in the battery model, five in the dynamotor model A directional loop is available for the receiver section as is a trailing antenna kit for the transmitter The battery operated transmitter uses four tubes, the dynamotor type five tubes Both models have amplified interphone connections and sidetone to monitor the output An incandescent lamp indicates antenna current A built in antenna loading coil, controlled from the front panel, permits use with a variety of effective antenna lengths



ACCELERATED PRODUCTION PLANNING

By the middle of this year Hamilton Standard Propeller production is expected to be ten times what it was in 1938. This will have been made possible by the production planning described in this article

By Arvid Nelson *Factory Manager, Hamilton Standard Propellers Division, United Aircraft Corp*

The following material has been gathered from a talk given by Arvid Nelson, the author to the Army Ordnance Association, and the American Society of Mechanical Engineers at a meeting held recently at Cleveland, Ohio. This summarized material presents the important steps in planning taken by the Hamilton Standard Propeller Division of the United Aircraft Corporation in carrying out their remarkable accelerated production schedule

HAMILTON STANDARD propellers, in common with the rest of the aeronautical industry, has had and is having its problems of capacity, schedules, and priorities, and, to date, has been able to meet and, at times, even anticipate greatly accelerated schedules To do this long term planning was necessary which presented a tremendous problem and a new line of thinking

In order to have an accurate measure of the effort involved in the required task, Hamilton Standard has for some time used a unit of production which they call, in their terms, an equivalent two-way propeller This, of course, does not necessarily mean that the physical unit produced is an actual two-way propeller It is, however, the most nearly accurate measure which they have today to determine the requirements of man hours, floor space, dollar inventories, and a number of productive and non-productive workers From Fig 1, showing accelerated production, an indication is given of the magnitude of the expansion which the plant has undergone and that which is hoped to be accomplished. This chart starts in 1938. From 1935 to 1939, a fairly constant, normal growth was maintained, but in the last half of 1939 the growth changes from the normal business growth to a steeply accelerated production. There are four basic differences between the normal growth and the mushroom type of expansion

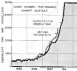


Fig 1

The first difference is a very rapid rate of increase at the beginning of the expansion period The second difference is the comparatively short period of peak production The third difference is that the volume at the peak is extremely high in proportion to the normal base Finally, at the end of the period, which is not shown on the chart, the rate of decrease will probably be very rapid These four differences in the two types of expansion must be considered in any planning for accelerated production

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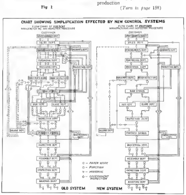


Fig. 2

BUYER'S LOG BOOK

What's New in Accessories, Materials, Supplies, and Equipment

A convenient hydraulic die handling truck is offered by Lyon Iron Works, Greene, N. Y., which is equipped with a winch for pulling dies on and off the table. Truck illustrated is of 1,000 lb. capacity with 24x36 in. table having a lowered height of 12 in. and an elevated height of 51 in. In its standard position, the table extends about 1 ft. beyond the edge of the wheels so that the table may be put close to the press when taking out or putting in dies. Table is arranged to revolve with stops at each 90 deg. and is hydraulically elevated with a two-speed hand pump. A motor-driven pump can be furnished with other capacities and specifications.—AVIATION, *May, 1941*

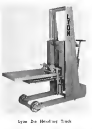
A new plastic known as Rezolin has been developed by *The Rezolin Co.*, Los Angeles, Calif., for the express purpose of eliminating high die costs without sacrificing speed of production. It is thought that wide applications to aircraft design can be made, including use as knobs, handles, fuse-holders, aerial clamps, aerial mast tips, etc. Rezolin is a liquid phenolic which may be poured into the mold but which hardens quickly under heat and pressure.—AVIATION, *May, 1941*

To help solve accurately and quickly aircraft navigation problems, *K-L B Instrument Co.*, San Antonio, Tex., has developed a new instrument, the Proportional Computor, Type E. Said to be so simple to use as to be applied with equal ease by either experienced or inexperienced pilots or navigators, the Computor has been flight tested by over 7,000 hr. use in the air. Exact ground speed is read directly by fixed index without any computations. Map and watch are the only supplementary equipment needed. Only one movement of the Computor is necessary, solution is then read directly on the one scale. All factors of wind velocity, drift, airspeed and ground speed are reduced to a single factor of time, under constant conditions. Made of durable nickel-silver, instrument can be carried in vest pocket. Sold exclusively by Air Associates, Bendix, N. J.—AVIATION, *May, 1941*

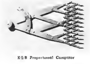
Substantial simplification in stockroom and production line handling is anticipated as a result of revision made by Adel Precision Products, Burbank, Calif. All Adel clips now use aluminum bonding material, eliminating necessity for 755-A coding previously required. Also eliminated is color differentiation of brown neoprene formerly used to distinguish aluminum bonded clip. Black neoprene is now used because of its improved quality over colored compounds. Adel will stamp all production clips with designation, "Alum. Bond," to differentiate new clip from original design black cushioned tinned copper clips manufactured by company.—AVIATION, *May, 1941*

Designed for high efficiency milling of small parts, *Sundstrand Machine Tool*, Rockford, Ill., announces a smaller Rigidmil, No. 00. Of unit type construction and automatic lubrication, this power feed machine has a hydraulically actuated table having a maximum stroke of 8 in. and rapid traverse rate of 400 in. per min. Feed and traverse strokes can be regulated. Equipped with a ¾ hp. spindle motor, an outstanding feature is the wide range of spindle speeds possible with the high ratio head. Between high and low speeds ratio is 42½ to 1, making possible the machining of practically all types of materials without sacrifice in production or finish for lack of speed range.—AVIATION, *May, 1941*

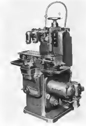
Ignition markers suitable for aircraft engines, have been perfected by *Irvington Varnish & Insulator Co.*, Irvington, N. J. These improved patented markers are said to meet the rigid requirements of both British and American aviation standards. Consisting of lengths of inside and out varnish-impregnated insulated tubing, on which suitable identification is screen printed with specially formulated ink, the marker is furnished in standardized lengths which are slipped over the wires to be identified. Two diameters (nominal I. D. .263 or .294 in.) are available with either of two heights of symbols, and in two standard lengths.—AVIATION, *May, 1941*



Lyon Die Handling Truck

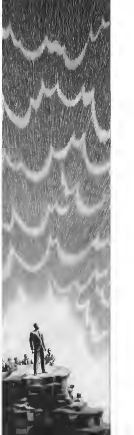


K-L-B Proportional Computor



Sundstrand Rigidmil No. 00

Irvington Ignition Markers




Jardur Aviation Chronograph

A highly useful aviation chronograph the Jardur No 960 waterproof, dustproof and shockproof 17-jewel time piece, made by the *Jardur Import Co*, New York, N Y, incorporates many features of value to the pilot Embodying latest developments of Swiss watch construction, this non-magnetic watch has an hour turning bezel by means of which the pilot is able to know instantly the actual gas or flight time remaining A tachometer translates time into speed and speed into time, and a 12 hr register, subdivided into ½-hr periods, tabulates immediately the exact time consumed in flight without any calculations A degreemeter for timing turns is another valuable feature and is calculated on the standard rate turn of 360 deg in 2 min Scale is plainly marked up to 180 deg for a 15 deg turn every 5 sec covering the complete revolution of the sweep hand in 1 min—AVIATION, *May, 1941*


Televiso Prod Vibrometer

No more yelling, "contact," "switch off," "throttle closed," etc, will be necessary for you lightplane owners, now that Aero Technical Industries, Pittsburgh, Pa, is getting out its Aero Starter Weighing less than 6 lb, the starter is said to do the work of 100 lb, and so simple that a 12 year old child can operate it with safety A single pull of a convenient handle on the instrument panel starts the motor—AVIATION, *May, 1941*

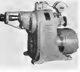
Innumerable production uses should be found in the aircraft industry for the Vibrometer developed by *Televiso Products, Inc*, Chicago, Ill As the name implies, the Vibrometer measures vibrations with micrometer accuracy from 00001 in to 1 in in four ranges, to an accuracy of 3 percent. The machine weighs only 19 lb complete and is fully portable The vibration pick-up is a hand tool which may be inserted into narrow and confined places—AVIATION, *May, 1941*

Curran "H-S" Gunk Compound

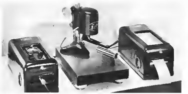
A complete decarbonizing process in package form is offered by *The Curran Corp*, Malden, Mass "Hydro-Sealed" for safety, Gunk Compound H-S is said to have been on service test for more than a year following the laboratory development stage and to make a perfect cleaner for decarbonizing carburetor and fuel pump parts, aluminum pistons, diesel engine injectors, etc Six or more ready-to-use "Hydro-Sealed" Carbon Gum Digestive kits make up a minimum initial wholesale stock order—AVIATION, *May, 1941*

A multi purpose unit for testing aircraft generators, vacuum pumps, hydraulic pumps, alternators, fuel pumps, etc, the U S Varidrive Aero Test-Stand determines performance of accessories at all speeds, and safety factors at speeds far in excess of engine speeds A product of *U S Electrical Motors, Inc*, with plants in Milford, Conn, and Los Angeles, Calif, the Test-Stand is made in both upright and horizontal types up to 15 hp Speeds of 715-5,000 r p m are obtainable for use on all commercial planes and routine tests on military aircraft, or 1,900-13,000 r p m for research into higher capacities and speeds for Army and Navy work Speed changes as small as 1 r p m can be effected and a positive-driven magnetic generator and speed indicator shows the output speed of the Test-Stand.—AVIATION, *May, 1941*

A fast repair on a special tap saved a mid-west plant from a serious production tie-up *Easy-Flo* silver alloy, produced by Handy & Harman, 82 Fulton St., New York, N Y, was used in brazing a 1⅞ in tap shattered in service and which could not be replaced by a new one in six weeks Broken in ten different sizes, the tap nevertheless was back in service in 4 hr, and three months later was still in use Actual brazing time for this exceptional repair job was but ½ hr, using only 3 in of $\frac{1}{16}$ in diameter Easy-Flo wire—AVIATION *May, 1941*


U S. Elect Aero Test-Stand


Tap Repair with Handy & Harman "Easy-Flo"



Brush SA-2 Surface Analyzer

Surface irregularities of less than one micro-inch in finished metals, glass, plastics, etc, may be accurately recorded with the Brush SA-2 Surface Analyzer made by the *Brush Development Co*, Cleveland, Ohio. These records show the amplitudes of irregularities in actual and not R M S values of micro-inches, also the number of irregularities in a certain area, indicating whether above or below the bearing surface. Analyzer head consists of pickup arm and its drive unit mounted on an adjustable stand. Pickup arm contains a piezo-electrical crystal actuated by diamond tracer point. Drive unit provides motion necessary for tracer point to explore the surface under test. Calibrating amplifier magnifies output of the pickup, and the direct inking oscillograph makes an inked record of the magnified surface irregularities on a continuously moving graph paper.—AVIATION *May, 1941*

Colonial Broaching Machine

Broaching machines are now available in a complete line of standard sizes ranging from 3 to 20 tons capacity and from 24 to 60 in strokes. *Colonial Broach Co*, Detroit, Mich, who also supply larger tonnages on order, offer pull-down type broaching machines with completely automatic handling of the broach, through use of a hydraulical handling mechanism located at top of the column. Pull down type broaching machines are especially advantageous under conditions where damage may result from the dropping of machined pieces, as in manufacture of precision parts for aircraft engines. The line of Pull-down machines follows regular Colonial welded steel construction. Length of stroke is adjusted by means of stops on the column. Manual operation is standard and the drive is hydraulic, fully enclosed. Speeds are variable normally 30 feet per minute down and 60 feet per minute on the return stroke.—AVIATION *May, 1941*

R-B-M "Package Unit"

Simplified aircraft production—an ideal toward which every manufacturer is working—may be greatly furthered by an ingenious "Package Unit" put out by *R-B-M Mfg Co*, Division of Essex Wire Corp, Logansport, Ind. An old, established firm, R-B-M will do a special job of supplying complete electrical equipment for aircraft according to particular operating and space requirements at a low price. With the Package Unit, simple installation is all that is necessary. A complete unit perfected to the last detail is carefully packed in an individual box, shipped to your storeroom and distributed to the production line as required, ready for final assembly. As manufacturing specialists, producing a variety of electric switches, relays, magnetic controls, wiring harnesses, etc., R-B-M is constantly engaged in the improvement and development of its products to assure the simplest design and most rugged construction.—AVIATION *May, 1941*

Eisler Multiple Spot Welder

One of the most interesting and promising items to cross our desk recently came from *Eisler Engineering Co*, Newark, N J, about its multiple electric spot welder. From two to 12 spots can be made simultaneously, depending on the nature of the job, and adjustments can be made to make circular, straight square, rectangular, or any odd-shape welds. Machine is primarily intended for spot welding of light sheet metal work where a large range of adjustments for various spots and shapes are to be considered. Pressure electrodes are used with suitable air operation equipment and have individual adjustment to maintain an even pressure on all spot welds being made.—AVIATION, *May, 1941*

Heath Lightplane Radio

An unusual lightplane radio is the self-contained unit brought out by *The Heath Co*, Benton Harbor, Mich With but one wire to attach (to antenna) and all batteries enclosed in a sliding drawer inside the 5x6x4½ in case, the set is permanently mounted in instrument panel with brackets supplied by the manufacturer Of special interest is the handy instant switch from beam frequency to control tower which eliminates need for changing tuning dial Complete aircraft band is covered—weather beam and control tower—with operation good in any climate Weighing 6 lb with batteries, set includes radio frequency and circuit is RCA licensed super-heterodyne—AVIATION, *May, 1941*

Skyview Sportair Camera

Often while flying you want to take a picture of your new airport, or of a classy new job tootling along just under your wing tip, or maybe just to satisfy a hidden artistic urge aroused by the scenery *Skyview Camera Co*, at its new home in Olmsted Falls, Ohio, has designed a Sportair Camera, which fills a definite need in camera equipment Using standard 3¼x4¼ in filmpack, the camera, ready for action, weighs only 3¾ lb with 7½ in. overall length, has full corrected anistigmat f4.5 lens, and a shutter speed from 1/10 to 1/200 of a second A brilliant direct view finder gives a large upright image Complete with filter, range finder, photo electric exposure meter, flash synchronizer and carrying case—AVIATION, *May, 1941*

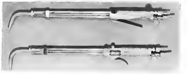
Stanley "Flud Lite" Eye Shield

New "Flud Lite" Eye Shields for use on all grinders is announced by *Stanley Electric Tool Division*, New Britain, Conn Fitted with two bayonet type light bulbs it throws light directly on grinding wheel and work Design and lighting arrangement provides 30 percent more visibility than previous models Eye shield is adjustable up or down, but cannot be moved to non-guarding position No 600 "Flud-Lite" Eye Shield comes complete with two light bulbs, bolts and instructions for mounting and connecting—AVIATION, *May, 1941*

Having the remarkable property of neutralizing furnace gases, the *Lithco Atmosphere Furnace*, developed by The Lithium Corp, Newark, N J, heats both alloy and carbon steels, and iron, without decarburization, carburization, or scaling A carrier gas, generated within the furnace, entrains vapor which evolves continuously from the cartridge refill and bathes the work being heated Danger from injurious and explosive gases is eliminated from Lithco Furnaces which are fully automatic, with no motors, pumps or moving parts Extremely simple, the furnace is a completely self-contained unit with low operating and maintenance costs Temperature range—1200 deg F min., 1800 deg max. continuous Dimensions, 65 in high 38 in. wide 85 in long shipping weight 4250 lb—AVIATION, *May 1941*

Greater convenience in removing riser heads from metal castings can be had with a new line of hand cutting apparatus introduced by *Air Reduction*, New York, N Y Consisting of two torches and three tips, the new Airco apparatus is also used for removing rivets and for regular and other special applications New torches, styles 3180 and 9080, are of straight head type, each 21 in in length Both have monel metal heads and stainless steel tubes, cutting oxygen can be controlled by either lever or trigger, and type selected can be placed on top, on either side, or on the bottom of torch to suit the operator New cutting tips are known as style 187 bent to 75 deg, style 181 bent to 90 deg and style 191 which is a straight tip 7 in long—AVIATION *May 1941*

Lithco Atmosphere Furnace HD-812-4



Air Reduction Cutting Torches

THE AVIATION NEWS

BLAINE STUBBLEFIELD Washington | C F McReynolds Pacific Coast | Jay P AuWerter, New York | E. R. Leckin, New York | MAY 1941

Lovett is Assistant War Secretary for Air Ability Praised; Discuss Navy Air Assistant

Washington (AVIATION Bureau)—Officials here who know Robert A Lovett say that his appointment to the post of Assistant Secretary of War for Air brings to the Air Corps the leadership of a competent airman and executive which will be important in strenuous times ahead. Mr Lovett was Commander of the Northern Bombing Group of the Navy air arm operating over the North Sea during the World War He has been serving as aviation assistant to Secretary of War Stimson

The air secretary's office was created by law in 1926 and was filled until 1933 by F. Trubee Davison Since then it has been vacant. The law simply says the assistant secre-

(Turn to page 99)

Army Steps Pilot Training to 30,000 a Year Both AC & Contract Schools to be Increased

Air Corps has increased its rate of training pilots from 12,000 to 30,000 a year, and of air mechanics from 45,000 to 100,000 Corresponding increases are made in training of navigators and bombardiers.

The first class under the new program will enter training late this year Twenty-eight civilian contract flying schools have given the ten weeks elementary under the 12,000-a-year program. The basic and advanced training has been conducted by the ten Air Corps schools Initially, ten more Air Corps schools are planned to augment training under the new schedule It is expected also that additional civil contract schools will be chosen

Maj Gen G H Brett of the Air Corps indicated two of new AC schools might be located at Pueblo and Colorado Springs

The National Aeronautic Association expresses opinion that this pilot training increase may be followed by still another NAA says also that the Army's present backlog of applicants for pilot training is now about 5000, and that physical and educational requirements may have to be lowered and more recruiting technique applied to meet the quota.

The Army has three training centers Maxwell Field, Montgomery, Ala , Randolph Field Texas, and Moffett Field, Calif

Around each of these centers are numerous primary, basic and advance training schools. Each of the three training phases lasts ten weeks, 30 weeks in all New classes start every five weeks Age of trainees ranges between 20 and 26

NOT SO FEW instruments as was first believed are used in the German Messerschmitts. The picture of the cockpit above of the Me 110 shows that all of the standard flight and engine instruments are used as well as those for blind flying. Notice that several of the instruments have been removed, probably by persons now in possession of the plane for disassembly and minute study The Me 110 is powered with two 1150 Daimler-Benz motors. Examiners found few faults in the plane, mentioned only a blind spot directly below, and thin armor covering the pilot

HANDS ACROSS THE SEA (CARIBBEAN). Not so long ago the Aeronautical Chamber of Commerce was host to special aeronautical missions from Brazil and Argentine who were here to survey our equipment The visit was an important one and some of the top men in the industry were on hand. Included in the party were, left to right, Captain J. Mendes da Silva, Brazilian army air corps; Robert E Lee, vice president, Sperry Gyroscope Company, Colonel Antonio G Muniz, Brazilian army air corps, Arthur Christie, United Aircraft Corporation, Colonel Roy M. Jones, eastern district supervisor, United States Army Air Corps, Mr Meigs, Colonel Antonio Parodi, head of the Argentine aeronautical procurement mission; Colonel Jouett Captain Kenneth Whiting, general inspector of U. S naval aircraft, eastern division, Colonel Pedro Zanni, air attache, Argentine embassy, Washington, and Captain Feliciano Zumelzu, Argentine army air corps

CPT Upped $7,000,000

Washington (AVIATION Bureau)—In a burst of enthusiasm for the civil pilot training program as a "vital need in our defense preparation", the House added an extra $7,000,000 to budget estimates for CPTP operations for the coming fiscal year, providing a total of $25,0000,000 The Budget Bureau had recommended only $18,000,000 as against last year's $37,000,000, which the House termed "much too drastic a reduction"

In approving the higher figure, the House over-rode objections of Rep John Taber (R, N.Y.) that CPTP is "a waste of money", and delivered a light slap on the wrist to the Army Air Corps for not, like the Navy, giving CPTP graduates "appropriate credit" for civil pilot training experience on enrollment in military pilot training courses "There should be complete cooperation and understanding among the Army Navy and Administrator of Civil Aeronautics to the end that they will all work together for the consummation of the main purpose of the whole defense effort", the appropriations committee stated, adding that 22 percent of Army aviation cadets are drawn from CAA's program

Although there appears to exist considerable disagreement among War Department officials as to the military value of CPTP, the Air Corps seems inclined to support the program Jessie Jones, the Secretary of Commerce, is a strong believer in the value of civil aviation in the emergency

House Cuts Port Fund CAA, WPA, Disagree

Here's how the civil airport program adds up CAA, a couple of years ago, recommended a six-year program of 4000 ports at a cost of $560,000,000 Congress, turning its attention to other defense needs, provided $40,000,000 for this fiscal year to go ahead with a schedule of 250 ports certified as necessary to defense, 188 of these are under way For this year, CAA asked $33,500,000

The House cut the amount to $28,500,000, on the ground that WPA should spend more of its money on airports and thus help defense The CAA airport section would like to have $80,000,000 to finish the job, and will try to get the Senate to raise its ante Actually, CAA and WPA are scrapping over the job of building airports

In the Army there is wide disagreement about the strategic need of ports Officers' estimates vary all the way from 100 to 1000 The easy way for Army is to move into big civil fields—by invitation of the cities that own them Then the Army tells the port to clear the training flivvers out of the air, and a lot of people get mad Privately some officers will tell you they don't expect any war on our soil, or any huge air force, and we don't need fields Others strongly emphasize that we might need them and should take no chances

WHEN BAD WEATHER HELD UP DELIVERIES these 171 new Piper Cubs accumulated at Lockhaven This is two weeks of production.

CAB Makes Study of Propeller Accidents

CAB has issued an excellent survey of propeller accidents These accidents usually result in fatal or serious injury, and are the result of carelessness Every one of the 41 accidents reviewed was preventable.

The propeller is difficult to see in motion Some pilots make them more apparent by painting the tips. Every pilot should see that his passengers get to and away from his airplane safely, even if it means stopping his engine.

Before starting the engine, the pilot should make sure the chocks are placed Starting the engine without an experienced assistant invites accidents Pilots should turn and taxi carefully to protect bystanders from sand and stones thrown by the blast

When the flying public demands it, manufacturers will provide suitable starters for the small planes The addition of good brakes should eliminate a large percentage of these accidents, and allow the pilot to remain at the controls when starting his plane.

House Reduces Funds For Civil Aeronautics

Washington (AVIATION Bureau)—Civil aviation is suffering financial reverses as Congress, overwhelmed by the use of national defense appropriations, seeks to pinch pennies on non-military activities In approving $79,856,000 for CAA and CAB regular expenses for next fiscal year, the House slashed almost $25,000,000 from Federal funds for civil aeronautics as compared with last year's appropriation Chances seemed slight that the Senate would reinstate the reductions.

Increases were granted, however, for two activities—maintenance and operation of air navigation facilities were raised by $2,103,450 over fiscal 1941 to a total of $14,000,000, and the item for safety regulation was hiked $483,043 above last year to $2,712,000 But both totals are still somewhat below estimates by the Budget Bureau All other CAA operations were pared as compared to both last year's appropriation and budget estimates As approved by the House, the current bill (annual Department of Commerce supply bill) also provides: establishment of air navigation facilities, $6,700,000, technical development, $500,000, CPTP, $25,000,000; airport development $28,500,000, general administration of CAA, $975,000; general administration of CAB, $1,176,000, and operation of the new Washington National Airport, $290,000

The House also cut $45,000 from a Weather Bureau request for a half-million appropriation for weather aids to air navigation.

In general, the House appropriations committee, which recommended these reductions, reflected the view that "demands for every economy possible" necessitate curtailment of civil aeronautics programs But curiously, in so doing the committee cited rapid development of commercial flying over the past few years as "perhaps greater than in the previous 35 years"

Six Ports for Alaska

Before winter, says Col. Donald H Connolly, Administrator of Civil Aeronautics, at least one usable runway on each of six new airports in Alaska, located and engineered for defense, will be in operation The new fields are at Juneau, Cordova, Boundary, Big Delta, West Ruby, and Nome. All are in construction or awaiting bids on work to be done during the summer Alaska's share in the $10 000 000 civil airport program is $3,300,000 Independent of the airport appropriation, simultaneous radio range and broadcast stations are being installed adjacent to the new fields There are now 12 radio range and communication stations and 17 more will be installed during 1941-42

Enlisted Men Will Fly

The War Department looks toward the use of enlisted personnel as pilots, with the Navy planning to increase its percentage in accordance with recommendations made by the special board appointed last Fall

The Navy will offer greater opportunities for enlisted men to take flight training and probably will undertake a specific program to that effect. This allows them to accept otherwise-qualified men who fall short of the educational standards

All Aid Short of War

By-product of the blitzkrieg was seizure by the Nazis of Paris headquarters and records of the Federation Aeronautique Internationale, governing body of sporting aviation groups throughout the world and official custodian of flight records The Germans now want the Aero Club of Germany recognized as spokesman for aviation

The National Aeronautic Association, "consistent with the U S foreign policy of non-recognition of forcible changes in sovereignty by the axis powers," refuses to recognize the claims of the Berlin club and has invited **FAI** members throughout the world to submit documents on flight records to NAA headquarters

NAA Meets in Louisville

National Aeronautic Association's annual convention will be in Louisville, Ky, the first four days of June Frank Tichenor will head the guest speakers committee; there will be prominent speakers from aviation in this country and abroad Other chairmanships agenda, Bill Redding, credentials, Roger Wolfe Kahn; resolutions, Harry Coffey

Harris & Ewing

Any pots and pans today, lady? Britain collects used aluminum for less vital parts of aircraft.

Spot Checking

New Orleans-Central America service, applied for by both Pan American Airways and American Export, was set for hearing on April 30 as this was written

Wanted, according to some capable military prophets, a multi-place, stoutly-armed fighter to scrap the Nazis' Focke-Wulf Kurier Some say it might be the FM-1 Bell Airacuda

Brewster Aeronautical Corp's "Penguin Flying Club" with 150 flying members, thinks it is the biggest plane manufacturer employees' club It will use Cubs with Lycoming engines

Pan American Grace Airways starts third weekly schedule down West Coast South America to Santiago There are four schedules weekly on PAA's East coast run, which gives the U S a 3½-day schedule via either coast in either direction

Plastics for aircraft got a new boost when the Senate increased an appropriation of $632 500 to $1,000,000 for operation of Department of Agriculture Forest Products Laboratory at Madison, Wis Interest centers in plywood and plastic wood

American Export Airlines was granted re-instatement of $800,000 appropriation for starting transatlantic mail service this fall, but at this writing the issue still was to be debated by the Senate Opinion is that Export will get the fund, eventually, even if turned down this time

Transatlantic speed record was set by 4-engined Boeings being delivered to Britain Estimate was, though unofficial, that time was under 8 hours

Battle for custody of the nation's civil airport program, between CAA and WPA, seemed going in favor of WPA CAA's request for $80,000,000 was drastically chopped Object in giving it to WPA is to turn as much relief work as possible into national defense.

Production has started on Wright Aeronautical's new 2,120,000 sq ft engine plant at Cincinnati and the first Cyclone will be turned out in June

Since January, 1940, U S airplane factory area has increased 150 percent, says the Aero Chamber of Commerce ACC also says American bombers exceed all other nations in speed, lift, and range

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Quick Watson! The Jewels!

Nine British airmen, aboard the first of six Boeing clipper boats delivered to Pan American, indicated it is one of the three that PAA has turned over to the British It crossed from Los Angeles to Miami in 12 hours 52 minutes Opinion still is that Britain will use the boats to ferry pilots back to the U S

A Messerschmitt 110, two engines, two 20 mm cannon and four machine guns, rated at 365 m p h at 18,000 feet, is in the hands of Vultee for study It was shot down in Britain The Messerschmitt was first noticed in Poland, in 1939, when it wrecked locomotives en route with its shells

General Motors now is a full-fledged aircraft manufacturing concern, turning out airplanes, engines, and propellers—North American bombers, pursuits, and trainers, Allison power plants, and GE hydraulic pitch-controlled propellers which will come into production in July.

By Spring, 1943, England will have accumulated, above losses, around 100,000 war planes, including U S exports. It is doubtful, the experts say, whether ground facilities would handle that many But it is anybody's guess where the vortex of war will be by that time. The British can attack from Africa if they can hold it.

We hear that Martin is developing a new and different plastic for broader fabrication of aircraft parts. The story is that the company doesn't expect it to figure in the present war, but expects great things later on No statement could be obtained from Martin officials at this writing

If all the world fights, as now seems likely, a large proportion of its surface shipping will be sunk Some aircraft manufacturers, a bit hopefully perhaps, think that new over-sea air cargo ships can pick up the load and carry on

You've been hearing that further "refinements" of air war will see bombers operating from 40,000 to 50,000 feet, beyond the reach of AA guns and pursuit and interceptor fighters. Reason given by the experts is that pursuits are not easily pressurized It's difficult to hold even pressure in a small enclosure, and uneven pressure is damaging to pilot behavior

Don't forget the jewels. If you think it's simple to run a defense boom, please note that the government has had to go out with $45 000 and expand a plant to make more jewels to make instruments to equip airplanes

A new night interceptor is being developed by the Air Corps, especially adapted to night fighting. Two experimental jobs are being built by an aircraft manufacturer Externally, it looks like any other interceptor, an expert said Probably the design is based on British experience. The British have been working on air carried sound detectors for aiming at night, and on powerful air-carried searchlights

The Stubblefield Award goes to Northwest Airlines for a two-page news release breaking all records, it has *nothing* to do with aviation, It's all about a stewardess named Jeanie Lafitte who is looking for a pirate's cache and if she finds it she'll be "happy, oh, so happy"

CALLING NAMES

J. Fred Coots and Nick Kenny write a song entitled "From Frost to Flowers (In Just Eight Hours)" and dedicate it to Eastern Air Lines Great Silver Fleet

Maurice E. Sheehan is named auditor of revenue for United Air Lines at Chicago

Air Scouts of America starting in Washington D C, has rented a glider to start. They hope to expand nationally

William H. Bird, director of New York 23rd Street Assoc. opens seaplane base on 23rd Street. Night run taxi planes to La Guardia Field

Lt. Col. Elmer D. Perrin, inspector at Martin for AC and procurement officer for that district promoted from Major

James F. Lincoln Arc Welding Foundation cites numerous contributions to the progress of the aircraft industry

Associated Aviation Underwriters opens a new branch office in Dallas.

William V. C. Buxton, president of British American Ambulance Corps forms "Wings of Mercy" committee to raise $500,000 for a fleet of flying ambulances

E. A. Schurman resigns as superintendent of uniformed guards of the U S Treasury to accept post of chief of protection of The Glenn L Martin Co

Sen. McCarran introduced a bill to establish a Division of Aviation Education in the Office of Education which is under the Department of Interior

William L. Timbers is named manager of surface transportation relations for United Air Lines

James F. Gillies goes with Chicago Pneumatic Tool to assist in general sales activities

Samuel B. Fuller Jr is appointed chief of materiel branch, Division of Production OPM replacing **W. A. Harriman**, now in London as special representative of the President

C. Bedell Monro, president is among 21 employees of Penn Central to receive 10-year service pins

Miss Dickey Mayer, formerly in TWA news bureau handles press liaison work for Lear Avia at the New York office

R. J. Brugge is welding consultant and engineer for Lincoln Electric Co. at Washington particularly arc welding in the Defense program

Glenn L. Martin, president of Glenn L. Martin Co. is reelected as are **J. T. Hartson**, exec. v p; **H. F. Vollmer** 2nd v p; **W. B. Ebel**, 3rd v p; **M. G. Shook**, treas & asst sery; **T. H. Jones**, sery

Justin W. Dart, gen mgr of Walgreen Co. is elected a director of United Air Lines

G. A. Barker is appointed manager of Johns-Manville's public utility and electrical products department

Walter Brown is made vice president general counsel and a director of Western Electric Co

Lewin Barringer, author of "Flight Without Power", is named a director of Brigadeb Aircraft

James H. Habegger is elected to board of directors and appointed treasurer of Aircraft Accessories Corp

Freeman Albery succeeds **Daniel C. Sayre** as Chief of the Safety Rules & Education Division of CAB. Sayre reenters the field of journalism

International News

THE HEMISPHERE DRAWS MORE CLOSELY together as five Venezuelan army officers take refresher courses at Randolph Field. L. to r., Major Jorge Marcano, Lieut. Luis Calderon, Lieut. Felix Moreno, Lieut. Paul Sierralfa, Lieut. A. J. Maldonado

Allen W. Dallas of Washington D C, is appointed liaison engineer for Fleetwings. Was recently director of airplane fire research for CAA.

Major John F. Morris becomes assistant director of Civilian Pilot Training Service at CAA; his former post of regional superintendent of CPTP at LaGuardia is taken over by his assistant **Capt. William W. Bachelder**

W. D. Albaugh, formerly treasurer of Thompson Products is upped to v p in charge of replacement divisions and **J. D. Wright**, formerly secretary, to secretary treasurer

Thomas J. Biely, with American Bosch Corp since 1923 receives newly created post of sales manager aviation division

Hugh Knowlton Kuhn Loeb partner is elected a director of Eastern Air Lines

Forrest E. Watson, Oklahoma rancher, drops his 40e a day smoking budget into piggy bank. 4125 days later turns bank over to Aeronca in exchange for 1941 Super Chief

R. B. Nisbet steps from purchasing agent to executive v p of Laminated Shim Co. **E. R. Young** from factory manager to v p in charge of production. **Richard Seipt** from sales manager to v p in charge of sales

Dr. James V. Price is appointed assistant flight surgeon for American Airlines at LaGuardia Field practiced in Bolivia for past 18 years

Victor Carbonara, for years chief production engineer and works manager for Kollsman Aircraft Instrument Division is appointed vice pres of the Square D Co

J. Linzee Weld, treas and gen manager of Suncook Mills assumes duties of president succeeding late **W. Rodman Peabody**

Otto W. Winter is elected first vice pres of American Society of Tool Engineers

William Samples, Jr. is new city sales manager in new American Airlines office at San Diego. **W. B. Stevans** is promoted to sales correspondent in the New York office now sales manager at Newark is **Charles A. Botfield**. **Barek Smith** ups to asst western sales manager. **Bradford B. Gibson** transfers from El Paso to Nashville as city sales manager. **Dolph Radcliffe Jr** is now asst south western sales manager at Dallas

J. T. Masenck is elected president and treasurer of Bresso Corporations. **J. F. Lucas**, v p and sery; **A. Langstaff Johnston**, v p; **Emile L. Bob**, v p

Lauren W. Atler, chief tool designer for Engineering & Research Corp. is named production manager for Colgate-Larsen Aircraft.

Miss Willie Peck, Braniff's chief hostess is promoted to superintendent of passenger service—believed to be first and only woman to hold such a position

H. E. Ingalls winner of AVIATION'S Maintenance Award while maintenance supt. for American Airlines is appointed maintenance engineer for proposed Seaboard Airways

William W. Britton is made special representative for Pacific Coast territory for Jessop Steel Co., with headquarters in Los Angeles

Paul Helms succeeds **Harry A. Cassler**, resigned as purchasing agent for Roller-Smith Co

Lou R. O'Connor is appointed representative for Ampco Metal in Washington, Oregon, Idaho and Western Montana

Henry H. Berr becomes western manager for Weatherhead Co out of Los Angeles

Edwin J. Appel is appointed manager of new Long View (Washington) aluminum reduction plant of Reynolds Metals

Capt. L. H. Dice of Eastern Air Lines presents his flight reports to passengers in poetry—no rhymes June with moon

EDMOND R. DOAK, Pres. and Gen. Mgr., Doak Aircraft Co., Inc.

Timothy E. Colvin leaves Fruehauf Trailer to join Aircraft Accessories Corp as sales engineer

Mjr Arthur H. Ziegler is appointed general counsel of the Office of the Administrator of Export Control

B. F. Bower, chief engineer of Hosrll Co. resigns to organize a company soon to go into production on tube fabricating machines

Herbert W. Lange is appointed chief engineer in the fire division of Cardox Corp. With Underwriters Laboratories since 1928

Thomas E. Dunn resigns as director of The Bullard Co. to be succeeded by **George L. Todd**.

H. B. Weihmiller, formerly eastern representative and v p of Consolidated Aircraft, who has been away from the company for approximately a year, rejoins in same capacity.

Marion Law, Jr., appointed public relations director for Edward G. Budd Co. was in charge of N. Y. office of TWA News Bureau before joining Budd two years ago

Bert W. Holloway, onetime publicity executive with Universal and Paramount Studios is named publicity manager for Lockheed Aircraft and Vega Airplane according to **Leonard Schwartz** director of public relations. **Maxwell Stiles** continues as assistant publicity manager for Lockheed and Vega.

Walter Wollaston, for many years general production superintendent at Brunswick Balke Collender Co. goes with Vega Airplane as works manager

Sgt. Marley J. Fogleman, Sgt. Carson C. Clappsaddle, Pvt. Adam Blum, Pvt. Bryan Murchison, and **Pvt. Walter D. Blakely** receive the Soldier's Medal for heroism for their rescue of two officers and five enlisted men from a burning plane at Muroc Bombing Field Calif May 27 1940

Jack Warner, v p of Warner Bros mails check for $10,000 to Lord Beaverbrook for British Spitfire fund

Coming Events

May 12-13 Originally scheduled date for National Production Meeting of SAE at Milwaukee Wis has been postponed. New dates to be announced when established

May 19-23 Western Metal Congress and Metal Exposition Pan Pacific Auditorium Los Angeles, Cal

May 23-24 2nd Annual Aviation Conference of New England

May 30 Memorial Day Cruise to White Sulphur Springs W Va sponsored by Aero Club of Pittsburgh Pa

June 1-4 NAA Annual Convention & American Aviation Forum Louisville Ky

June 1-6 SAE Summer Meeting The Greenbrier White Sulphur Springs W Va

June 4-6 11th National Air Carnival Birmingham Ala

June 12-14 Eastern Photoelasticity Conference at Cambridge Mass, under auspices of Dept Mechanical Engineers MIT

June 28-July 13 12th National Soaring Contest Elmira, N Y

Aug 17-18 Sheldon Air Show Sheldon Aero Club, Sheldon Iowa.

Aug. 25-Sept 2 3rd Annual American Open Soaring Contest Joliet, Ill

Sept. 17-19 Nat'l Petroleum Assoc 39th Annual Meeting Hotel Traymore Atlantic City N J

Oct 2-4 Nat'l Assoc of State Aviation Officials Annual Convention, Providence R I

Oct 30-Nov 1 SAE Nat'l Aircraft Prod Meeting Biltmore Hotel Los Angeles, Cal

U. S. Gets Naval and Air Bases in Greenland Strategic Mid-Sea Patrol and Ferry Station

Washington (AVIATION Bureau)—This country's protectorate over Greenland for the duration, by administrative agreement with Denmark, owner of the island, (1) provides a naval base from which our North Atlantic flank will be guarded; (2) establishes U S territory half way across the Atlantic to which we can legally convoy British shipments, (3) provides military air base sites from which possible enemy fleet operations may be observed right up to the shores of Europe, using Iceland (now in the hands of Britain) as a second easterly jumpoff; (4) sets up a midway station to which bombers for Britain may be flown by American crews, and affords a fueling post which would enable planes to carry more cargo, (5) brings up the possibility of flying medium weight craft to Britain If the Faeroes Islands north of Scotland are used no jump on the route would be more than 800 or 900 miles.

Washington regards President Roosevelt's deal for Greenland as a master strategic move. The agreement was made with the Danish minister here, and although the Nazi-dominated Danish government hotly repudiated the deal, it was helpless to prevent the action. On its southern tip are deep sheltered fjords that would harbor the entire U S Navy These waters are excellent for sea plane operation Construction of land airports will not be quick or easy; terrain is extremely rugged and few level spots exist But the Navy and the Coast Guard have made recent surveys, and Mr Roosevelt's language in the agreement indicates that such construction is feasible. One big disadvantage is foul weather Cold air streaming down from the 6000-ft ice cap generates heavy fogs along the coasts And worst of all, ice locks practically all harbors much of the year

Distances: New York to Julianehaab, at the southern tip of Greenland, 1800 miles, but more than half of this is over land, with airports available. Nanortalik, southeast Greenland to Reykjavik, Iceland, 800 miles, all water. Reykjavik to London 1150 miles, one third over Scotland and England, with Faeroes and Orkney Islands as sit-down spots. Look at your map or you won't get it

Air Corps Freight

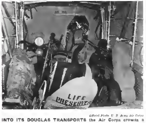
Air Corps is operating an air cargo system that may produce valuable experience and data for the future civil air freight system AC has 44 C33s and C39s plying between its four depots and making local trips to air stations and aircraft factories, and on a regular weekly schedule to the Panama Canal, with occasional runs to Alaska

The Douglas planes are specially designed, with reinforced floor frames and extra big hatches in the sides Chief item on freight manifests is airplane engines Swift transport of new and overhauled engines save the expense of keeping many spares on hand, enables AC to deliver new ships from factory to field and return engines for another delivery—there is still a shortage of engines All manner of special parts, urgently-needed materials for factories, special equipment, and even personnel when necessary, are carried Cargo capacity is about 3200 pounds. Assembled propellers are fastened under the fuselage, in the air stream; two of them cut the speed about ten miles per hour

The official name of the cargo transport unit is "Fiftieth Transport Wing", Field Service Section of the Materiel Division On the basis of miles flown and traffic moved, the Wing would rank as the sixth airline of the U S Pounds cargo moved in the first six months 1940 4,034,000; passengers carried 2345; miles flown 1,928,000; hours flown 16,398.

Trips to Panama use only the C-33 Jungle kits are carried by all members of the crew Pay loads are limited to 2200 pounds. No more than five passengers are carried. Up to ten planes may go together, departing from Duncan Field for Brownsville on Sunday, so as to co-ordinate with Pan American Airways' trip

The Army announces no plans, but observers believe the Air Corps freight system may be expanded on a large scale if the emergency increases.



Official Photo U S Army Air Corps

INTO ITS DOUGLAS TRANSPORTS the Air Corps crowds a variety of cargo. Equipment is securely tied during flight

AC Wants Specialists

From 800 to 1,000 reserve officers, graduated and commissioned from the ROTC, will be sought annually for the Air Corps Reserve Corps Area and Department commanders are authorized to recommend the appointment as second lieutenants in the Air Corps Reserve, a number not to exceed 10 per cent of prospective ROTC graduates who qualify for a commission Students with commissions who complete their ROTC in June may apply immediately for transfer to the Air Corps Reserve

The Air Corps is in need of reserve officers qualified in technical specialties for duties in connection with supply procurement, and is particularly interested in those graduates who have majored in aeronautical or mechanical engineering and business administration

New Schools Organized For AC Technicians

Expanding its training program for technicians—ranging from airplane mechanics to weather forecasters—the Air Corps is forming two new schools at Biloxi, Miss, and Wichita Falls, Texas Rate of training is being stepped up from 45,000 a year to 100,000 Each of the new schools will take in 800 enlisted students every two weeks for 22 weeks of training as aircraft mechanics At present, the Corps operates four other technical schools and technicians are being trained at fifteen civilian contract schools including those at Chanute Field, Rantoul, Ill.; Scott Field, Ill ; and at Denver, Colorado

Lovett Appointment

(Continued from page 93)

tary for air shall aid the Secretary in fostering military aviation—a broad definition which permits the air assistant to make what he can of the job.

There are two other offices of assistant secretary for air in the government: (1) Assistant Secretary of Commerce for Air, once filled by William P. McCracken, Clarence M Young, and Ewing Y Mitchell, now vacant. Robert Hinckley is Assistant Secretary of Commerce, in charge of Civil Aeronautics Administration, but not of CAB, and he has other than aviation duties, (2) Assistant Secretary of Navy for Air, which was once filled by Edward Warner and David Ingalls, has been vacant since 1932

The present Undersecretary of Navy is James Forestal He is reported very active in the Navy air arm, and in close understanding with Lovett. At once, upon Lovett's appointment, Washington speculated on whether F D R would appoint a Navy Assistant for air Forestal appears to be qualified, but such an office would be lower in rank than the Undersecretaryship position which he now holds

The airlines are pleased with appointment of Lovett because they believe he has taken a reasonable stand on allocation of aircraft for transport Likewise the National Aeronautic Association has high praise for him, and presumably he is sympathetic with non scheduled flying The War Department gives no information as to plans for the new office

They only need to SEE as far as the Instrument Panel

Learadio Direction Finders Rely on Mallory Capacitors and Selector Switches . . .

Mallory's leadership in supplying essential precision parts for broadcast, amateur and commercial radio communications was bound to extend into broader fields. Today, Mallory Precision Parts have important roles in every field utilizing radiated electrical impulses.

Manufacturers such as Learadio, whose direction finders have brought a new degree of exactitude to aircraft navigation, know that they may depend upon Mallory for parts which reflect the most advanced design and practical efficiency.

Precision Parts, however, are just a portion of Mallory's service to aviation. Airport lighting with ribbons of Mallory Tungsten . . . electrical contacts of Mallory Metals for aircraft ignition — Vibrapacks* for dependable portable power . . . Welding tips, wheels and dies of Mallory Alloys . . . these are just a few of the ways in which Mallory serves nearly every phase of aviation. Use the signature below as a check list against your own needs. P. R. Mallory & Co., Inc., Indianapolis, Indiana. Cable address—Pelmallo

Standardization Result Of Lend-Lease Buying

Washington (AVIATION Bureau) Lend-lease procedure for buying airplanes for the British is still being worked out, but general outlines are clarifying. The immediate job is issuing of new contracts to manufacturers for planes to be delivered under the $7,000,000,000 British aid appropriation These orders in the main cover production now under way on existing U S contracts, deliveries on which will be deferred.

Once it is decided what job a given manufacturer is to do, working out of contracts is turned over to Army or Navy, depending upon which service regularly deals with that firm Contract terms are to be substantially the same as used on ordinary U S military procurement

Standardization as between British and American equipment is a major objective No sudden upsetting moves in this direction are planned however, except perhaps in cases where the same ship, with minor differences, is being delivered to the two air forces A trickier situation is presented where a firm is building one plane for the U S and another, with the same tactical purpose and perhaps a basically similar design, is being built for the British Examples are Douglas's two attack bombers—the British DB-7 and the U S A-20—and Martin's two medium bombers—the 167 or Maryland, and the B-26

In cases such as these it is planned gradually to coalesce the two models through a series of design changes, rather than to disrupt production of one or both assembly lines by a sudden standardization It is possible too that this government may decide to adopt some American models which only the British have been buying here for the RAF.

Doak All-Wood Trainer

Edmond R Doak, president of Doak Aircraft Co, Hermosa Beach, Calif, has announced inauguration of an intensive program to develop and manufacture aircraft and aircraft parts of wood to help meet the shortage of strategic metals In addition to production of numerous wood parts, the Doak Aircraft Co is shortly introducing an all-wood basic trainer

SELF-SEALING FUEL TANKS are being put into the new Douglas bombers Exterior of tank is a fireproof fabric, while interior is material impervious to gasoline. Between is a layer of rubber composition which swells to close a bullet hole.

Money Is Provided For Detroit Bombers

Knudsen's plan of last fall for assembly in government-owned plants of bomber parts to be manufactured by auto firms got into the money stage when Congress provided just under a billion dollars for 4,600 bombers This represents a year's production under the plan starting in the spring of 1942 In addition to the four assembly plants the government is building new plants for several of the auto firms in which to do the parts fabrication For Ford, a $10,989,000 plant at Ypsilanti, Mich For General Motors, a $6,875,000 expansion of the Fisher Body plant at Memphis

Regional Bargaining Pushed For Air Labor

Washington (AVIATION Bureau) Apart from the CIO organizing drive, the big pending issue in aircraft labor relations is the question of regional collective bargaining through employment stabilization committees of the sort which OPM director Hillman is setting up in the shipbuilding industry If these regional agreements work out well, Hillman hopes, apparently with administration support, to extend the plan to aircraft

Essence of the plan is that representatives of employers, unions, and the government from a more or less homogeneous region get together and work standard conditions of employment for all firms in the area with the major aim, at least ostensibly of reducing migration of labor from one plant to another Hillman sees it as a useful formula for industry generally, he applied it first to shipbuilding, setting up groups on the West Coast, the Gulf, and in the East

His next attempt is to be in aircraft, but he may have tougher sledding—basically because the labor situation in that industry is in an extreme state of flux No one outside the government is enthusiastic about the plan

In spite of this general lack of interest, the administration seems likely to make the attempt

More Federal Money For Plane Plants

Further federal-financed expansion of aircraft plants is to be accomplished with part of a billion and a quarter dollars available for plant construction of all types How much of this money will go into airplane and parts factories will not be decided until British and U S representatives thrash out the details of coming military requirements.

Indications so far are that the same general procedures will be used in spending this money as those under which about $833,000,000 has already been laid out, — emergency Plant Facilities contracts and Defense Plant Corp. leases under which the government pays for, and eventually owns, expanded facilities of plane manufacturers, plus a few cases of outright government construction of plants.

New Aircraft Parts Subcontractor

With initial production begun on Vidal plastic material, Allied Aircraft Corp is operating in North American's former Baltimore plant Comprising 65,000 sq ft floor space, plant's capacity is 500 men, and includes a 7 ft 100 m p h wind tunnel

Heading the new company is R. E. Breed III, formerly president of Bristol Aircraft

Wright at New High

Achieving a new monthly high output of Cyclone and Whirlwind engines, totaling 1,430,000 hp during March, 1941, Wright Aeronautical Corp of Paterson, N J, has surpassed the production program scheduled a year ago May

Redesigned assembly lines now progressively assemble an engine every 25 minutes Improved equipment and tooling instead of duplication of casting machine processes were principally responsible for the rapid production increase. Also contributing to record output was expansion of floor space in Paterson from one plant of 900,000 sq ft. in Sept. 1939, to five plants now totaling 2,858,900 sq ft.

Only 142 days after ground was broken for its Cincinnati factory, Wright Aeronautical began producing engines in that plant. Production was started on April 14 in the 2,120,000 sq ft. plant, which is said to be the largest single-story industrial plant in the U S

The first four production lines are "pilot lines" which contain some of every type of machine needed to produce engines. Use of this method permits the company to place machines in operation as fast as they can be received Everything that Wright has learned in its many years of engine building is being used in the new plant. In-line methods are employed on a major scale Largest machines in the plant are two Greenlee machines that turn out a finished cylinder head every two minutes.

ASSEMBLY LINES

By Robert Colborn

Months of preparation, plant construction and tooling are finally beginning to bear fruit in rapidly expanding plane production, and monthly output figures will now begin to show real progress. Factory space actually in operation increased 26 percent in the first two months of the year to 24,122,000 on March 1, and the large number of new models introduced at the turn of the year are getting into real production

March output of military and commercial types totalled 1,216, up from 972 the preceding month. Particularly encouraging is the rise in combat types, believed to total nearly 600—more than twice the output of fighting ships achieved as recently as last December. A little over 600 were trainers, and about 25 commercial ships were produced

Major items in the training plane output are the Stearman primary trainer, the Vultee basic trainer, and the North American advanced trainer, all in quantity production. Both Stearman and North American have now delivered more than a thousand trainers each

Total production for 1941, Knudsen expects, will reach 18,000 units

Experimental model of North American's version of an Allison powered pursuit is now under test by the Air Corps. This ship, the XP-51 is an all-metal low-wing monoplane. Weighs 7,000 lb., has a 37-foot wing span, and uses a three bladed prop. Air Corps has telescoped the period between test and manufacture in the current program, and unless some bad bugs show up, P-51 should be in production in a few months

Republic has completed manufacture of the service-test run of its YP-43 "Lancer" pursuit and is at work on the mass-production run. The P-43 is the Army's only pursuit using air-cooled power; it is a lineal descendent of the bumble-bee-like P-35 used by the Air Corps and the Swedes. Powered by a P & W 1,200 hp radial and weighing 6,900 lb., it develops 375 m.p.h. in the export version, is specially super-charged for high altitude operation

Republic has in preparation a more advanced model, the P-47, using an engine in the 2,000 hp class. Production waits on the completion of plant expansion now underway and, presumably, availability of the engines.

LATTERLY SUPERINTENDENT OF MAINTENANCE for Northeast Airlines, Albert J. Olson is now with Simmonds Aerocessories as development and service engineer. He will be in charge of development of the complete Simmonds line, with headquarters at Vergennes, Vt.

A second Beech twin-engine advanced trainer, the AT-10 is being tested by Air Corps. This ship, powered with two 280 hp engines is primarily for flight training, whereas the larger AT-7 is for instruction in navigation. The AT-10 has a wooden fuselage of monocoque design except that the pilot's compartment is metal. It weighs 5,300 lb., has a 37 ft wing span, retractable landing gear, two-bladed 7.75-ft. propellers

Menasco is in production on its 160-hp four cylinder aircooled engine for use in Vega 35 trainers. Menasco is building five four-cylinder engines daily, will be in production by late summer on a new 400 hp geared six.

Accident prevention in aircraft plants was given a going over at the annual meeting of the New York Safety Council. Big problem is that such a large proportion of employees are green hands, don't know how to keep from getting hurt

Lloyd Stearman, has been placed in charge of aircraft design and engineering for the Harvey Machine Company, Los Angeles. Stearman was president of the re-organized Lockheed Aircraft Corp until 1935 and then helped organize the Stearman-Hammond Company

First basic training of Army Air Corps Flying Cadets ever to be conducted at a civilian flying school is now in progress at Cal-Aero Academy's training center at Ontario, Calif

General Motors expects to be actively in the propeller business by July, when production will start in the new Dayton plant of its Aeroproducts Division on the hydraulic propeller design it recently bought from Engineering Products, Inc. Present factory has 193,000 sq ft., will soon be doubled. Initial production is on a high horsepower size suitable for pursuit aircraft

Now that manufacturers are delivering long series of identical airplanes, a lot of people think there's no need to make elaborate tests to ensure that each plane meet weight specifications. Proposals to substitute tests on a few sample airplanes, as well as to somewhat simplify the tests, were worked out at a Wright Field meeting of manufacturers, Army, Navy, CAA and OPM people. They have been submitted for approval to the Army-Navy Joint Aeronautical Board.

Production of jeweled bearings for aircraft instruments is increased by a 7,562 sq ft. expansion of the Perth Amboy plant of Moser Jewel Co. Defense Plant Corp. is putting up $45,000

Three-fourths of all aircraft plants are operating on a three-shift basis, and two of the largest are on a seven-day week. Eighty-eight percent of workers in the industry work a six-day week.

Floor Space Survey

A survey released by the Aeronautical Chamber of Commerce shows a 150 per cent increase in floor space for Pacific Coast aircraft builders since January, 1940. Expansion statistics are as follows

	Plant	Floor Space		
		April, 1941	January, 1941	January, 1940
1	Boeing	2,17[illegible],000 sq ft	1,500,000 sq ft	709,000 sq ft.
2	Consolidated	2,345,000	1,700,000	961,200
3	Douglas	1,949,000	1,999,998	1,900,000
4	Lockheed	1,650,161	1,259,337	985,008
5	North American	1,014,000*	1,014,006	650,002
6	Northrop	405,000	218,250	10,900
7	Ryan	240,000	180,000	80,000
8	Vega (Lockheed subsidiary)	1,206,481	178,270	170,000
9	Vultee	1,577,000**	1,025,000	574,000
	Totals	12,798,857	8,003,388	5,110,009

*Does not include Dallas and Kansas City plants of more than 2,000,000 sq. ft.
** Includes Vultee divisions at Nashville, Tenn., and Wayne, Mich.

GLENN L. MARTIN'S BOMBER PLANT at Omaha is now under construction and should be finished by October. Bomber parts made by subcontractors will be shipped here for assembly. The factory is expected to complete 200 bombers a month. Building design by Albert Kahn

Recent Awards

War Department

Bendix Aviation Corp., Bendix, N. J., $112,064 for maintenance parts for instruments
Bendix Aviation Corp., Bendix, N. J., $247,944 for maintenance parts for air motors
Goodyear Tire & Rubber Co., Inc., Akron, Ohio, $1,3?3,173 for brake assemblies
Wright Aeronautical Corp., Paterson, N. J., $124,612 for parts for engines
Weston Electric Instrument Corp., Newark, N. J., $214,241 for assemblies bulbs
Bendix Aviation Corp., Bendix, N. J., $221,064 for assemblies.
Bendix Aviation Corp., Bendix, N. J., $370,476 for indicators and transmitters
Electric Auto Lite Co., LaCrosse, Wisconsin, $123,907 for gage assemblies
Bendix Aviation Corp., Bendix, N. J., $744,173 for maintenance parts
Wright Aeronautical Corp., Paterson, N. J., $570,564 for maintenance parts
Bendix Aviation Corp., Bendix, N. J., $300,255 for supercharge regulator assemblies
Bendix Aviation Corp., Sidney, N. Y., $450,887 for distributor and magneto assemblies
American Bosch Corp., Springfield, Mass., $325,710 for magneto assemblies
Curtiss-Wright Corp., Buffalo, N. Y., $110,975 for engine mount assemblies
Aviation Mfg. Corp., Williamsport, Penna., $1,512,333 for spare parts
Bendix Aviation Corp., Bendix, N. J., $146,300 for indicator assemblies
Bendix Aviation Corp., South Bend, Ind., $134,499 for maintenance parts
Charles Fischer Spring Co., Brooklyn, N. Y., $115,639 for cushion assemblies
Republic Aviation Corp., Long Island, N. Y., $625,288 for maintenance parts
Square D Company, Elmhurst, N. Y., $666,000 for all major assemblies
North American Aviation, Inc., Inglewood, Calif., $792,733 for maintenance parts
Bendix Aviation Corp., Bendix, N. J., $2,520,216 for starter assemblies
Leece-Neville Co., Cleveland, Ohio, $1,595,420 for generator assemblies
Bendix Aviation Corp., Bendix, N. J., $607,048 for generator assemblies
Aircraft Accessories Corp., Kansas City, Mo., $117,845 for assemblies
Curtiss-Wright Corp., Caldwell, N. J., $376,950 for propeller assemblies
United Aircraft Corp., East Hartford, Conn., $131,439 for maintenance parts

Navy Department

Sperry Gyroscope Co., Inc., Brooklyn, N. Y., $122,436 for gyro compass equipment
Sperry Gyroscope Co., Inc., Brooklyn, N. Y., $877,294 for gyro compass equipment

Latin America Supresses Axis Airlines

The past weeks have not been very happy for German and Italian interests in Latin America, not only did the South American republics follow the United States' example in seizing Axis freighters, but Peru went one step further and took over the whole establishment of the German Lufthansa Peru, which included at least two airliners, and all ground equipment.

In addition, Pan American Grace Airways took one of the first concrete steps to combat further expansion of Axis owned or controlled airlines in South America, by starting a semi-weekly air service in Ecuador between two important inland cities, in direct competition with the German "Sedta". On the other hand, the expansion by German airlines in this hemisphere is made easier by ships slipping through the blockade with new equipment, in this way they have received at least two modern transports, new personnel and a considerable amount of spare equipment.

The Italian "LATI" will be given one more chance by Brazil, an official announcement said The airline, which maintains the last air connection between the Axis and Latin America, paid a large fine for unneutral actions on Brazilian territory and was informed that the next case would result in immediate cancellation of all existing contracts and agreements

A new service between New York and Toronto will be inaugurated by Trans Canada Airlines, pending CAB approval

Chinese National Airways. Pan Am subsidiary, will open a line from Chungking and Hongkong to Calcutta and Delhi in British India.

The past months saw a beginning on a network of airfields between Canada and Alaska, for joint use of Canada and the United States, and the furthering of hemisphere defense

American Export airlines will probably receive $800,000 for their proposed non stop transatlantic service, pending congressional approval

Swedish ABA Results For 1940

Despite the war, operations during 1940 of the Swedish ABA appear to have been satisfactory Connections are now being maintained between Stockholm, Malmoe and Copenhagen, Berlin, Mariehamn Abo, Helsingfors, Riga and Moscow, and have been flown practically without interruptions

Figures for 1940, compared to 1939, follow passengers 32,000 (60,000), seat occupancy 70% (40% per cent), miles flown 1,050,000 (1,800,000) mail 506,000 lb. (1,270,000 lb.) and freight 1,083,000 lb. (2,470,000 lb.)

Wide World Radiophoto

FOCKE-WULF 189 is one of Germany's new planes to go into combat this spring. It is a short-range reconnaissance ship, with a general similarity to the Lockheed P 38.

On Schedule

By "Vista"

"Britain carries on" is the slogan that is heard so often in the present days, and as far as England's far flung air-routes are concerned, they are carried on Little has been published about the British Empire's airlines since the war began, and it is not generally known that more than 95 per cent of all pre-war mileage is being flown on regular schedules by British Overseas Airways This company, originated from the rival Imperial Airways and British Airways in a government reorganization plan, now is the prime representative of England in Africa, Asia and Australia, and is doing an excellent job in these difficult times

About 30,000 miles per day are flown by BOAC's airliners, with passengers, mail and freight, and though there are Government requirements for space because of the many official personages and cargoes that have to be carried, a respectable number of passengers are brought to their destinations with the same old efficiency that was so noteworthy before the war Actually, there have been no accidents during wartime operations, though of course the "Clyde" was lost in the hurricane in Portugal last year, and the "Corsair" made an unscheduled landing in the African jungle, but it was repaired on the spot and flown out by Capt. Rogers, one of England's ace transport pilots.

On the whole, all routes are flown with the well-known Short boats, but BOAC's equipment is notably international, and consists of Lockheed 14's and Lodestars, Junkers and Focke-Wulfe, besides English types such as the Ensign landplanes, Short boats and De Havilland Flamingoes

During the summer months of the past years, and continuing through the winter season, a route to Bermuda was shared by Imperial Airways and Pan American Airways With the seasonal stoppage in 1939, there were plans to send over a newer and better boat to reopen this service as Airways Bermuda Ltd., but the war changed all this, and in due time most of the flying boats that could be spared were taken over by the British Government, thereby eliminating British flight schedules, and Pan American was left to continue the service on its own This summer, however, the Atlantic will again be crossed by English planes, operated by Airways Atlantic, a BOAC subsidiary, using a new type Empire boat, the Short S-30 C Class, with a gross weight of 53,000 lb., thereby continuing the service which was maintained last summer In addition, the three Boeing 314A's obtained from Pan American by the British may be turned over to BOAC and used on the Empire routes, thereby making more planes available for the other services, especially the bottleneck between England and Lisbon, at present served by Douglas DC-3s and Short boats

A rather remarkable story came to New York from Buenos Aires, which would indicate that some sort of an interchange of courtesy exists between the Axis and Britain, at least as far as commercial airliners are concerned It has always been more or less striking that none of the transports still flying in Europe, or from Africa to South America, have ever been shot at, and except for the mistake of a rookie Nazi, who took pot shots at a KLM DC 3 earlier in the war, killing one passenger and riddling the plane, no attempts have been made to bring an airliner down There have been many stories about enemy airplanes escorting transports with notable passengers on board, but no one has ever given a lucid explanation of these facts The story now goes that as long as the Axis leaves Britain's "last link" to Lisbon open, England will not interfere with the Italian LATI airline from Portugal to Latin America This somewhat curious tacit understanding enables the Axis to keep its war-valuable line to Brazil open, and on the other hand does not force Britain to maintain a North Atlantic airline in winter, impossible with present equipment due to the frozen-over harbors at Botwood and Montreal.

Five advisory councils to coordinate and control Douglas Aircraft activities have been set up and the following changes effected: CARL A. COVER, left, is made executive vice pres; GEORGE A. STROMPL, right, becomes director of inspection standards for all plants, H. O. Houghton is named factory mgr. of new Long Beach plant, George R Tulloch, asst. mgr.; H. E. McCann, supt; G. A Huggins, director of tooling for all plants

Flight to London was made by EDWARD WARNER, vice chairman of CAB on leave of absence to assist W. A. Harriman, personal representative of Pres. Roosevelt in England, as technical advisor

H. R BOYER assistant to A J Brandt, succeeds him as chief of Manufacturing Unit, Aircraft Section, OPM. President of Allen Corp., Mr. Boyer was formerly works manager of Pontiac.

Busy TOMMY TOMLINSON, substratosphere flyer and vice president in charge of engineering for TWA has been named chairman of a 14-man subcommittee of NACA to study deicing

Gladys Mitchell Studio

The new firm of Aircraft Components, Inc at Van Nuys, Cal., has as president GILBERT G. BUDWIG, former director of air regulations for Dept. of Commerce, and long a member of NACA.

L. B. CAMERON (above) was elected president of the Aircraft Parts Mfr. Assn. He is secretary treasurer of Interstate Aircraft & Engineering Corp. H. F. BAKEWELL is vice president

In 1922 W K EBEL joined Glenn Martin Co as draftsman, rose to chief engineer and chief test pilot, is now made director and vice president in charge of engineering, retaining his post of test pilot.

Elections result in two new vice presidents at Vultee. W. E. BURDICK (l.), formerly director of Army and Navy contracts and in the sales department, was one time test pilot and sales representative for United Aircraft. Of HUGH M. FENWICK (r.) (in charge of sales), Vultee says, "His work in aircraft sales here and abroad will be particularly valuable His activities will include marketing Stinsons"

JOHN SANDERSON (l.), vice president and director of Sperry Corp., takes on additional duties through his election to vice president in charge of finance for Sperry Gyroscope Co. He has been vice president, treasurer and director of Sperry Corp. since 1933. At the same time JAMES E. WEBB, heretofore personnel director and assistant to the president of Sperry Corp., moves up to treasurer of Sperry Gyroscope Co.

The Reynolds Metal Co has appointed HOWARD E. EMIGH as superintendent of its new mill located at Lister Ala. Among past jobs he has served as general consultant for OPM

New material department of Republic Aviation is headed by LT. COL. HARRISON W. FLICKINGER (l.), who controls purchase and handling of all materials and continues his former post of director of exports. DON PARKER, JR., assistant director of exports, becomes executive assistant of the department ALLAN DYSART (r.), with Curtiss and Consolidated before joining Republic in 1935, is made chief of inspection department.

Steam Engines for German Warplanes?

By Dr. Leo Handel

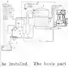
Reports reaching the United States that Germany is about to launch one of her "secret weapons" in the form of an invisible bomber made of transparent plastic material were received here naturally with utmost reserve, even though this news was endorsed by the *Aeroplane*. It is possible this was powered by steam, which would not be the first time that the steam engine was used in aviation. One of the first airplanes ever designed, the "Avion" by Clement Ader (which is exhibited in a museum in Paris) was equipped with a steam engine. In more recent aviation it was mostly this country which tried to give the steam engine a chance.

The steam engine for this particular purpose was promoted in Germany for economic reasons, and war and military uses. These units use comparatively cheap fuel oil which is much easier for Germany to obtain than the expensive high octane gasoline for airplane motors.

One very important feature of the steam engine from the military angle is its silent performance, even though the din created by the propellers could hardly be eliminated, this fact constitutes an additional difficulty for anti-aircraft defense. Other advantages of the steam engine in aviation are the decreased fire danger due to the kind of fuel oil used.

These ultra-modern steam engines on which Henschel experimented have very little in common with the standard machines. The fuel used, as mentioned above, is a special, high grade oil. It is induced under high pressure into the steam generator, a special kind of carburetor adds air in a certain ratio and this oil-air mixture is ignited by a plug. The steam is gradually generated in a spiral pipe of very small diameter which is sometimes more than 500 feet long and should reach its highest tension exactly at the end of this spiral just before it enters the cylinders. The exhaust from the cylinders leads to a condensor and the same cycle starts all over again. The loss of steam and/or water is extremely low on these new models. It might be mentioned here that fluids other than water were also used in some experiments and that the water has first to undergo a special treatment. The revolutions per minute can be stepped up to 2000 and more.

The schematic drawing shown just below is based on an automobile steam engine. However, the principal is identical with that for airplanes up to point 5 where either power unit can



be installed. The basic part of the unit is the boiler (1) where the steam is gradually generated in a seamless spiral pipe, which has a very small diameter and often is more than 500 ft long. The steam should reach its highest pressure at the extreme end of this spiral just before it enters the cylinders (5) through the regulation valve (4). Its temperature rises there to 450 deg Centigrade and the pressure reaches 100 atmospheres or more. The exhaust from the cylinders is connected with the condensor (radiator) (8) where the steam is cooled, and converted into water which is led to the container (9). The exhausted steam drives the small turbines (6) and (7). Turbine (6) operates the air pump (10) and the electric generator (12). The first one provides the heated air for the carburetor, the second one fires the spark plug, which operates the plug continuously and charges the battery. Turbine (7) drives the fan of the radiator.

The container (9) provides for water replacement, acting as a reservoir. The water is pumped (3) into the boiler and the same cycle is repeated.

The fuel is induced over the pump (11) in the fire box (2). All these constructions have a special, sometimes three-way, safety device, because an over heating of the steam beyond a certain degree must be prevented as it would lead to an explosion.

The steam engines of the latest constructions of this kind have 2 or 4 cylinders. The revolutions per minute can be stepped up to 2000 or more. It is conceivable that Henschel managed to produce a steam turbine for the airplane in question even though the high r.p.m.'s presented a seemingly unsolvable problem in this connection.

The problem of these steam engines is twofold. First of all it is extremely difficult to find the correct dimensions of the various apparatus to bring them in accordance with the heat value of the unit which must work entirely automatically. Secondly, even though the weight of such an engine is comparatively very low, it is difficult to create an engine which is small enough to be used in an airplane. The weight per horsepower is in practically all cases below 2 lb., and further research should bring this well below this figure.

Wright Field's Hurricane-Maker

A 40,000 hp motor that will drive air at a 400 mile-an-hour clip through Wright Field's new wind tunnel was tested recently for the first time in Westinghouse Electric's East Pittsburgh works. It is expected to be installed and ready for operation by July 1.

Combination of this motor and the 616 ft. wind tunnel is designed to test full-size plane propeller and engine enclosures as well as to create actual flying conditions for new military aircraft models. Ability to increase both the size of the experimental models and the speed of the air stream in the new tunnel will enable Air Corps engineers to obtain more accurate performance information than was possible before.

The wind-maker is the largest induction motor ever built, weighing 125 tons and standing about 15 ft high. A steel shaft 18 in in diameter will transmit the motor's 40,000 hp., and when operating at top speed the motor will consume more than 30,000 kw of electricity. Despite its size, the speed of this giant induction motor can be varied from 37 to 297 rpm.

Combined weight of the 16 bladed fans totals 12 tons, each fan measuring 40 ft. high. At top speed a retaining force of over 200 tons per blade is required to prevent each blade from tearing away.

Pre-doped Airplane Fabric

Defense manufacture of aircraft may be speeded by use of a new "pre-doped" silk fabric developed recently by a Cleveland paint concern. Paint shops under present production methods form one of the bottlenecks of the industry. With the new product, made by Sherwin Williams Co., complete elimination of the present painting process is said to be possible.

Produced in rolls of various widths, material has a heavy dope coating on one side of the cloth. This is dry enough to work with, but becomes hardened after being removed from its sealed airtight container. Applied to the framework of wing, fuselage or tail surfaces, fabric tightens as it hardens.

In the March 1940 issue, page 44 credit was inadvertently omitted for the sketches of the celebrities attending the Institute of the Aeronautical Sciences meetings. They were done by Elizabeth Korn.

CALLED THE "SLOSH TESTER," this device was developed by B. F. Goodrich Co. to test self-sealing fuel tanks. Device rocks the fuel tank in 16 to 18 cycles a min. to measure the effect of the force of the sloshing fuel on the tank.

Committee on Ice

Washington (AVIATION Bureau)—A special committee to study de-icing problems in air operation has been set up by National Advisory Committee for Aeronautics, with strato flyer Tommy Tomlinson, chief engineer for TWA, as chairman, and 13 other experts. One or two meetings have been held already. Ice formation on plane, propeller, and in the carburetor, are still serious matters. Although this committee was announced almost simultaneously with a CAB report on the UAL Chicago accident, where ice was involved, NACA stated there was no connection. Mr. Tomlinson said that the use of exhaust gas to heat the wings is one possibility that will be studied. Observers said this proposal offers considerable promise. Some informed critics said the airlines have not tried all the possibilities known to them. NACA is reported to have several suggestions to be worked on.

Planes for the Lines

At this writing, OPM was scheduled to re-consider the airlines quota on May 1. The figure prior to that date was about 55 DC-3s and a score or so of Lodestars for this year. It is agreed almost everywhere that adequate standard equipment shall be available for operation and some expansion of the lines. Great confusion exists in federal agencies whether such developments as the DC-4, the Lockheed Constellation, and the Boeing Stratoliner should continue in view of their interference with the production of combat types.

It has been suggested to the War Department that the DC-4s on order by the airlines be taken over, when built, and used to ferry pilots back from England. There was no comment from the line operators at this writing.

TRAINING PILOTS is one of the biggest jobs on any airline today. This is one of TWA's Stinsons equipped for instrument flying instruction. Student A. T. Vance has no outside visibility from his back seat. Instructor is Hugh Davis.

PILOT'S INSTRUMENT PANEL on new Boeing 314-A. Instrument layout and control arrangement have been re-designed in light of past experience. Pilot now has a control for the pelican hook under the stern—pull of the lever releases stern mooring line. Other changes over old 314 include new Wright Cyclones producing 1600 hp. each, increase of fuel capacity from 4200 to 5400 gal., oil tanks of 50 gal. capacity in place of 75 gal. tanks, and addition of carburetor de-icing system. Daytime passenger deck capacity has been decreased from 74 to 55 passengers, but sleeping capacity is now 38 as against 34. Gross weight 84,000 lb.

CAB Reports 3 Crashes. EAL in Forced Landing

Washington (AVIATION Bureau)—Civil Aeronautics Board recently reported its finding that the UAL Chicago accident of Dec. 4, 1940 probably was caused by the failure of the pilot to exercise sufficient caution to prevent a stall in approaching the field, plus an error in judgment in choosing the short runway. The report states that the ship had accumulated ½ in. of ice on the leading edges.

The Board found that the AA accident of Dec. 11, 1940 at St. Louis, probably resulted from an attempt by the pilot to land off the runway, which was obstructed while scattered clouds hung below the 400-foot ceiling.

No report had been made on EAL's Atlanta accident at this writing. Investigation had started on EAL's forced landing, with 13 passengers in three feet of water near Vero Beach, Florida, April 3. Observers in Washington, commenting unofficially, said the ship was unable to hold altitude due to a combination of rain, hail, and extreme turbulence. No serious injuries to passengers resulted.

Concerning the TWA accident at St. Louis, Jan. 23, the Board found the cause to be the pilot's attempt at landing under adverse conditions, and in maneuvering for landing at a "dangerously low altitude." The Board recommended continuous monitoring of ceiling light projectors at all airports used by air carriers.

Meanwhile, both houses of Congress are engaged in an investigation of airline accidents, with the cooperation of the Air Transport Association, the National Aeronautic Association, and the operators.

Pick-up Picking Up

Pending before the Civil Aeronautics Board at this writing are applications for nine certificates, to serve 742 cities and towns in 26 states (service duplicates in 8). At present only one certificate, that of du Pont's All American company, is in effect. It serves 86 municipalities in six states.

The list of applications is as follows: All American, three, (in addition to its original one), Connecticut, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, West Virginia; Aero Pick-up Service, one, Virginia; Automatic Air Mail, one, Illinois, Iowa, Wisconsin, Minnesota, Mercury Development Corp., two, Michigan, Ohio, Indiana, Tennessee, Kentucky, Missouri, Illinois, Iowa, Oklahoma; Southern Aviation Corp., one, Kentucky, Tennessee, Alabama, Missouri, Mississippi, Illinois, Arkansas; Southwest Feeder Airlines, one, Arkansas, Illinois, Iowa, Kansas, Missouri, Louisiana, Oklahoma, Texas.

CAA Plans UHF and Instrument Landing

Congress has appropriated money for 57 new ultra-high frequency radio range stations, and for 16 blind landing experimental stations.

The UHF range is remarkably free from the tendency to split in multiples. For four years the Radio Technical Committee for Aeronautics has been working on this development. The first system operating on the new frequency (119,000 and 126,000 kc., as compared with present 200-400 kc.) will be ready for operation about May 1, on the New York-Chicago route. UHF will be most valuable in regions where there is radio congestion. CAB plans to equip 11 more airways with UHF, and, within 4 years, the entire 35,000-mile airway system. No deadline is being set for discontinuance of low frequency.

Of the original 10 instrument landing stations scheduled, funds allowed work to go ahead on only six, at New York, Cleveland, Chicago, Kansas City, Ft. Worth, and Los Angeles. In 1942 appropriations are funds for ten more, including one each at Atlanta and Oakland. The pioneer experimental station was at Indianapolis, where thousands of hooded landings have been made. Scheduled planes will start using the stations as fast as they are ready, when and if satisfactory experience is achieved, ceilings will be let down, with zero the ultimate objective.

Rates for the Masses

Southwest Feeder Airline's application for a certificate on a 10,000-mile "pick-up" system to serve eight states from Illinois South is the most extensive since CAB came into being. Thomas O. Hardin, chairman of the former Air Safety Board, is president. The system consists of 19 routes, which will not be "a competing service with trunk lines," serving 301 municipalities, 80 of them with passenger accommodations. Mr. Hardin aims to offer rates "within the reach of the masses." All American Aviation, the only pick-up system now operating, does not carry passengers.

AIR TRANSPORT INDICATOR

April 1, 1941

121.18

Which is the ratio of passenger miles reported by the Air Transport Association for all domestic lines for March 1941 to the figure for March, 1940. Total for the indicator has continued to rise from last year's low. For the three months of 1941 traffic stood at 216,985,301 revenue passenger miles—up 22.1 percent over February 1941.

See Finance page for individual companies' traffic figures.

Transport Doings

United Air Lines route No. 1 and PCA route No. 14 are authorized by CAB to serve Youngstown, Ohio. UAL'S Professor William A. Wheatley, states that 20,000 United educational kits for teachers have reached 800,000 students. Company applies for Denver, Grand Junction, Colorado, Las Vegas, Nevada and Los Angeles. April 16 is date for hearing on application to serve Boston and New England. Four months of training graduates 19 pilots from pilot training school at Tracy. UAL is holding its first cargo handlers' school at Chicago. Company announces it will apply for Denver-Los Angeles route supplementing service via Salt Lake.

American Airlines operates largest number of schedules out of NYC in its history (57 flights daily) by adding two round-trips to Chicago, one to Buffalo and one to Boston. Twenty-one graduate stewardesses put on AA wings.

Trans-Canada gives familiarization flights, Toronto-New York, non-stop.

Western Air changes name to Western Air Lines, Inc.

Eastern Air Lines and TWA apply for St. Louis-Washington, D. C., route, via intermediate points; hearings have been postponed. EAL applies for non-stop service on Route 5 between Birmingham, Ala., and New Orleans, La.

Braniff Airways completes $50,000 radio program, establishes transmitters and receivers with increased power at six stations, and applies for Dallas-New Orleans run via Shreveport, Alexandria and Baton Rouge.

TWA's president, Jack Frye, denies report that five four-engine stratoliners will be sold to British. Transcontinental joins airlines in plan to sell tickets on credit, cost must total $50 or more. TWA and New York, New Haven & Hartford Railroad are studying possibility of an air-rail hookup system in southern New England.

Chicago & Southern applies for New Orleans-Shreveport via Baton Rouge and Alexandria, La., and New Orleans-Dallas, also to operate new route with terminals at Memphis, Tenn. and Pittsburgh, Penna., via Paducah, Ky., Evansville, Ind., and Cincinnati, O.

Mayflower Airlines and E. W. Wiggins Airways asks for Nantucket, Mass., and Providence, R. I., and Mayflower for Boston, Mass. and Nantucket, via intermediate points.

By Raymond Hoadley

Changes in the excess profits tax law favorable to the aircraft companies enabled some companies to revise upward their 1940 earnings figures. Meanwhile the average profits of aircraft manufacturing and air transport companies in the forepart of 1941 may be somewhat under earlier estimates In the case of the plane makers exceptional costs in connection with expansion programs are holding down earnings despite record deliveries. Profits of some of the airlines are lower than a year ago due to the higher overhead charges necessitated by ambitious employee schedules. Although aircraft companies have first call on defense materials under the priorities system, shortages in magnesium and aluminum forgings among others are causing sporadic production delays in a number of important plants The supply demand problem in strategic metals probably will persist throughout the year even though supply facilities are being increased By fall the motor industry will have the task of finding 50,000 skilled workers to man their new aircraft engine and parts plants.

Lockheed's first quarter deliveries approximated $22,500,000, nearly as large as they were in half of the entire 1940 year. March was the largest month in the company's history. Lockheed has loaned $31,441,000 to its affiliate company, Vega Airplane Co Officials estimate that a profit of $1,350,000 will accrue to Lockheed from two British contracts that have been sublet to Vega

Bendix Aviation, largest of the accessory aviation units, now makes eighty specialized parts for which the company has a backlog of unfilled orders amounting to over $200,000,000 Another $100,000,000 in orders is expected out of the present program and new plants are under construction to enlarge capacity for lease-lend requirements.

Highlights of the Curtiss-Wright financial report for 1940 were a 185 percent increase in shipments, unfilled orders up to 400 percent, federal taxes soared 1,815 percent, net profits increased 199 percent while employment jumped 134 percent President Vaughan pointed out to stockholders that expansion plans were made with the idea in mind that plants wholly owned can be operated on an economically sound basis after the defense program is completed

Vultee Aircraft delivered 130 planes in March with billings for the month triple the February figure The half year ending May 31 probably will show a loss, but for the entire fiscal year ending next November the company expects to be in the black. Sales in 1941 may total $50,000,000, as against $6,000,000 in 1940

Along the automobile front—Ford Motor Co expects to turn out one plane engine an hour by early summer General Motors plans to be producing airplane propellers in July at the new Dayton division. Packard hopes to have a pilot plant ready in July which can turn out five liquid cooled engines a week The first official estimate of the dollar volume of plane parts manufacture for any of the automotive concerns places the Ford participation at $155,000,000

Air express revenues showed a super-colossal gain of 94 percent in February over similar 1940 month The gain was attributed partially to the interchange between plants of essential parts for airplanes and other defense projects.

Sperry Corp has a $150,000,000 backlog and expects 1941 sales to top $100,000,000, according to company officials Only 25 percent of the firm's backlog is in aircraft accessories, a smaller amount than is usually accredited to this company The larger share is in marine equipment

Changes in the excess profits tax added $1,118,000 to the 1940 earnings of the Martin Company while United Aircraft had a tax saving of around $2,000,000 Because of the virtual certainty that corporate taxes will be upped again this year, aircraft officials are at sixes and sevens over the proper tax charges to make against interim earnings in advance of Congressional action on the tax matter Higher corporate income taxes are anticipated and also larger excess profits levies

Glenn L. Martin Co's. sales in the first three months of 1941 were the highest for any quarter in history and almost double those of a year ago yet profits amounted to only about $1 70 a capital share, as against $1 97 last year As this was written the company was operating at only 75 percent of capacity due to shortages of metal forgings and castings as well as engines and propellers.

Recent stock market transactions by leading aviation officials include the purchase of 7,000 shares of Eastern Air Lines by Eddie Rickenbacker and 1,000 by Paul H Brattain, 1,100 shares of Pennsylvania Central Airlines by John L. Loeb, 3,500 TWA by Howard Hughes through Hughes Tool Co Sherman Fairchild sold 4,000 shares of Fairchild Engine & Airplane Co while J. Carlton Ward acquired a like number of shares Other sales included 700 Beech Aircraft by T A Wells

United Aircraft plans a $14,000,000 expansion which will bring total expenditures for new plants to $65,000,000 during the past two years In answer to a stockholder's inquiry regarding current earnings, President Wilson stated at the annual meeting that "there is no reason why we should be operating any differently than a year ago"

Industry Backlog

Unfilled orders of the aircraft industry have crossed the four billion-dollar mark for the first time and aggregate $4,030,000,000—four times as large as a year ago. In sharp contrast to the huge military orders now on the books of the industry, twenty-seven years ago, in the first year of the World War, Congress appropriated $300,000 for military aviation In 1917 this was jumped to $700,000,000 A score or more of additional aircraft plants will be built in preparation for the new orders that will flow from the lease-lend and supplementary defense appropriations These, like their immediate predecessors will be government financed for operation by the aircraft and automotive industries When the new facilities are completed, it is contemplated that 10,000 planes for the British and 15,000 for the American air force will be superimposed on the present 37,000 plane program Official estimates call for production of 18,000 military planes in 1941 The following table gives the latest approximate unfilled orders of twenty-five primary producers

Allison	$230,000,000
Aviation Corp	17,000,000
Beech	24,000,000
Bell	52,500,000
Boeing	198,000,000
Brewster	95,000,000
Buick	91,000,000
Cessna	65,000,000
Consolidated	215,000,000
Continental	40,000,000
Curtiss-Wright	700,000,000
Douglas	350,000,000
Fairchild	10,000,000
Ford	122,000,000
Grumman	63,000,000
Lockheed	260,000,000
Martin	300,000,000
N American	200,000,000
Northrop	61,000,000
Packard	188,000,000
Republic	56,000,000
Ryan	10,000,000
Studebaker	23,000,000
United Aircraft	420,000,000
Vultee	87,000,000
	$4,030,000,000

Current Earnings Reports

Company	Period	Net Profits 1940	Net Profits 1939	Profits per Share 1940	Profits per Share 1939	Sales 1940	Sales 1939
American Airlines	12 mos. Dec. 31	$1 858 550	$1 407 151	$4 77	$4 15	$20 689 610	$15 070 082
Aviation Corp.	3 mos. Feb. 28	198 093	L 157 447	0 54		2 460 600	
Boeing	10 mos. Dec. 31	374 655	L 2 284 073	0 34		19 390 718	
Borg Warner	12 mos. Dec. 31	6 730 402	5 583 301	2 88	2 43		
Canadian Colonial	12 mos. Dec. 31	10 220	L 1 252				
Continental Motors	3 mos. Jan. 31	524 237				4 073 072	
Curtiss Wright	12 mos. Dec. 31	15 [illegible] 974	5 218 258	1 80	0 39	153 720 000	48 589 000
Eastern Air	12 mos. Dec. 31	1 375 455	583 824	2 80	2 06	18 700 757	7 599 547
Fairchild Corp.	12 mos. Dec. 31	648 [illegible]		1 92	1 26	3 7[illegible] 001	
Fairchild E. & A	12 mos. Dec. 31	58 771	187 694	0 06	0 15	3 2[illegible] 994	
Grumman	12 mos. Dec. 31	1 415 [illegible]	892 063	2 79	1 85	8 [illegible]11 294	4 482 350
North American	12 mos. Dec. 31	7 000 336	7 068 092	3 06	2 06	38 803 514	27 608 851
Sperry Corp	12 mos. Dec. 31	7 854 170	3 462 061	3 90	2 71		
United Aircraft	12 mos. Dec. 31	13 139 085	9 275 436	4 94	3 53	126 754 830	81 101 590
United Airlines	12 mos. Dec. 31	775 462	777 534	0 52	0 52	11 172 845	7 621 800
Vega	12 mos. Dec. 31	71 084	86 311	0 10	0 21	1 850 554	582 168
Warner Aircraft	12 mos. Dec. 31	85 124	L 21 301	0 10		743 883	

L — net loss

Here and There . . . Penn-Central Airlines reports a gain of 42 percent in passenger traffic in the first quarter of 1941 while Northwest Airlines showed a 10 percent gain in the same period . . . United Air Lines' March traffic was up 13 percent . . . The Wright engine division of Curtiss-Wright Corp accounts for 55 percent of the parent company's backlog . . . Fairchild Aviation has $23,000,000 in unfilled orders . . . Square D Company officials state that orders on hand and in prospect indicate better profits this year despite higher taxes . . . Stockholders of Aircraft Accessories Corp have approved a new issue of 100,000 shares of preferred stock to finance the company's $2,200,000 backlog . . . Unfilled orders of Breeze Corp have grown to $13,500,000, with deliveries scheduled to increase each month this year . . . Trans-Canada Air Lines earned $539,000 in 1940, as against a loss of $411,000 in 1939 . . . Shipments of planes by Piper Aircraft have averaged three times the early 1940 deliveries with 617 Cubs manufactured in January and February compared with 205 in the same months last year . . . American Airlines increased its directorate to fifteen by adding H R Thompson and William Littlewood to the board . . . Republic Aircraft has arranged subcontracts with forty-eight firms . . . Ex-Cell-O Corp has a $16,000,000 backlog and 1941 shipments should total approximately $25,000,000, against $15,000,000 in 1940 . . . Northrop deliveries in the first three months this year amounted to $1,452,000—the company was not in production in the comparable 1940 period . . . Pioneer Parachute Co is producing 500 units a week and is working on a $1,000,000 United States Army order . . . Glen L Martin Co is the first of the large aircraft companies to declare a common dividend so far in 1941, a payment of $1.50 a share will be paid June 2 to stockholders of record May 20 . . . Eight major aircraft companies reported an aggregate sales rise of 159 percent in 1940 while profits increased 60 percent . . . Warner Aircraft's backlog stood at $1,750,000 at last report . . . North American Aviation has 3,000 planes flying in the world's air services . . . Canadian airlines have been adversely affected by a substantial decline in travel out of Canada due to war conditions.

Commercial air lines have been relieved of one of their big worries as it becomes evident that they will get sufficient new transport equipment this year to handle a 25 to 30 percent increase in traffic. While the airlines have not received all the equipment they wanted, most of them agree that A D Whiteside, commercial aircraft priorities chief in the defense commission, has treated them fairly Mr Whiteside made such a good record in aircraft priorities that he has been given an equally tough assignment in steel priorities

Personnel is giving the airlines more concern than equipment. W A Patterson, president of United Air Lines, pointed out to stockholders recently that high overhead charges are reducing earnings so far this year, although operating revenue is running 6 to 10 percent ahead United has 1,000 more employees than a year ago All the lines fear that the government may draw on some of their flyers before an adequate backlog of new trained men is built up

Defense officials estimate that aircraft manufacture will become a million man industry some time in 1942—nearly as many men as now work in the automobile and steel industries combined. Unfilled orders, too, are larger than the dollar volume of the automobile companies in their best year, 1929 In communities where aircraft plants are located they account for 20 to 30 percent of the entire city payrolls

Consolidated Aircraft stockholders have approved a unique proposal whereby directors who are not employees are placed on an annual salary basis

TO MAKE MORE VALVES for aircraft engines, Thompson Aircraft Products will soon have 5000 more men at work in this Cleveland plant Albert Kahn is doing the factory design.

OPERATORS CORNER

5 Bills for Gliders

Interest in gliding, for sport and especially for primary training, is increasing as the government threatens to clamp down on the manufacture of small airplanes not needed for defense There are at least five bills before Congress which provide from $500,000 to $5,000,000 subsidy for glider promotion. The question whether powerless flight on a large scale is desirable considering cost and efficiency is being debated again. Years ago, everybody went glider-happy but nothing much came of it This time, important development is a possibility One of the new arguments in its favor is that the cost is so low that boys and adult fans could afford to pay for their own training without much federal expense Charles T Malone, president of the American Glider Association, is working up a large following in Congress for the pending glider subsidy bills

More Airport Classes

Expansion of classes for airport ground service men on 14 new airports throughout North Carolina, South Carolina, Georgia, Florida, Mississippi, Alabama and Tennessee were announced recently by Col Donald H Connolly, CAA Administrator Similar classes have been in operation since the first of the year at airports in Maryland, Virginia, New Jersey, and New York, are next conclusion of a 90 day training period Trainees are capable of performing all airport service duties except those of certified mechanic. Acceptable ages are 18 to 35

WPA announces establishment of 17 similar service schools at Bendix, Basking Ridge and West Trenton, N J, Roosevelt Field, N Y, Boulevard Airport, Philadelphia, and Lock Haven, Pa, Curtiss-Wright Field, Baltimore and Hagerstown, Md, Byrd Airport, Richmond, Va, and Candler Field, Atlanta Courses are being set up at Raleigh, N C; Columbia, S C; Jacksonville, Miami, and Tampa, Florida, and Memphis and Nashville, Tenn.

The aviation school of the Wichita Engineering Co, Wichita Falls, Tex, has been approved by CAA Organized last June, the school now has 170 students Complete mechanical courses are given

New Advanced School for Air Corps

The Air Corps' newest advanced school, located at Selma, Alabama, began operations on May 1, with a quota of 300 students This is the advanced school of the south eastern training area and corresponds with Kelly Field Cadets will go to Selma for the third ten-week period of training

The field is the largest air port in the United States It is as large as LaGuardia and Maxwell Fields combined The field area is 9,000 by 5,000 feet, and an additional 2,500 feet will later be added to the length of the field It is estimated that the Army's largest plane could take-off and land, and take-off again in a straight line.

When all the construction is completed there will be more than 100 buildings on the field. A grand total of more than 3,000 officers, cadets, and enlisted men will be stationed here A new plan for quartering men in small groups of six is the first introduction of the Weaver Method to be used in the Air Corps Six men are assigned to one room in barracks and between each two rooms is a double sized bath There is also being built a number of low rental houses for the families of enlisted men, noncommissioned men, and civilian employees Commanding officer of the field is Commander Vincent B Dixon

Advanced Air Corps school at Selma, Alabama showing a view of the barracks

Foremanship Training At Republic

Republic Aviation Corp of Farmingdale, N Y has inaugurated a training course for foreman and would be foremen Groups of about 20 men attend class at one time Blueprint reading and other courses will soon be started by the company

Voters of Los Angeles are to be asked to approve a $3,500,000 bond issue at the next municipal election to expand and improve Los Angeles Municipal Airport Under the proposed expansion program an additional 305 acres of land east of the present field would be purchased and improved It is also proposed to erect a new administration and airline terminal building, and to provide additional runway drainage, paving, and other improvements.

Aviation Credit Corp. of St Louis has opened a new branch office in the Airport Terminal Building, Love Field, Dallas, under the management of Dan N Reagab

A survey just completed by the American School of Aircraft Instruments, Glendale, Calif, reveals that hundreds of trained instrument technicians are currently required at Army and Navy aircraft maintenance bases Such positions are under Civil Service and persons filling them retain civilian status Usual Civil Service rules apply and starting pay is $135 per month

So acute is the present shortage of trained instrument men, according ot Herbert W Hartley, president of the American School of Aircraft Instruments, that the Civil Service Commission has amended its requirements to recognize the school's six months' training course as a complete substitution for the two years actual experience ordinarily required for eligibility to these instrument positions

The Delehanty Institute now has about 500 in its aviation classes in New York City The school gives both a day and an evening course of 350 hours which costs $250 Instruction covers riveting, flat metal work, sub-assembly, and final assembly

Soaring Course

A summer course in gliding and soaring will be offered by the Elmira Area Soaring Corp Classes start May 1 and and June 27 Three kinds of courses are given: a novice course of two weeks, a power pilot's course of one week; and week-end or hourly training for the semi-skilled glider pilot or power plane pilot John Robinson, 1940 National Soaring Champion, will do the instructing

First public glider program is that announced by the State of Tennessee Glider veteran Hawley Bowlus has been named State Director of Gliding to develop Tennessee program. Aviation gas tax money is said to be available to support a substantial glider movement. Eight thousand boys and girls between 14 and 18 years of age have already registered for free courses High physical requirements must be met, as well as proof of satisfactory school grades and payment of $10 registration fee to cover incidentals J G Paulie, Director of Aeronautics for Tennessee, is man behind the game A Schweizer two place sailplane has already been purchased for primary instruction Student groups of fifty will be started first in Memphis, then Knoxville and Murfreesboro. Solo work in single-place utilities is to be added to curriculum State also plans subsidy for private glider groups of five to each plane

Spartan School

Air Corps cadets at Spartan School, Tulsa, Okla, have flown more than 70,000 hours since last July 1, according to Capt. Max Balfour, Director of the school The school has been growing steadily for many months Most recent addition to the building program is a large cafeteria and ultra-modern kitchen equipment

The aeronautical engineering course at Texas A & M is rapidly expanding and more than 600 students are already enrolled A student branch of the Institute of the Aeronautical Sciences has been established The local airport is being improved substantially and much flying activity is expected, both from private and Civilian Pilot Training Program students

Trainees at Cincinnati preparing for jobs with Wright Aeronautical Corporation. This group is studying a radial drill operation.

Wright Trains Workers

Wright Aeronautical has placed 1,000 workers on the payroll of its Cincinnati factory for immediate production This includes sufficient operators to man the high production machines installed in the first section of the 2,120,000 sq ft plant, and most of them are graduates of the company's training program This program will enable Wright to increase its personnel from 17,000 now employed in the Paterson area, to approximately 30,000, and accelerate its present production of over 1,300,000 hp monthly.

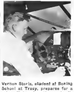
To meet the scarcity of skilled labor, a training program was evolved by Bartley Whitesids, supervisor of training, and P W. Brown, assistant works manager, which put 2,700 new machine operators into the five Paterson plants last year A survey was made of training facilities in the Cincinnati area and instructors and machines sent from Paterson to Ohio The typical trainee coming to Wright is healthy, in his early twenties, with a high school education, a good deal of mechanical ability, a great deal more mechanical interest, and is an American citizen He registers with the State Employment service, is given psychological tests, then goes to school for a week,—a school that teaches shop arithmetic, shop science, reading of operating sheets and use of measuring tools If he passes tests at the end of the week he is drilled far three weeks by Wright instructors He is again tested, rated for mechanical precision, and assigned to a machine When a job is available he is notified to report for work. For two to fifteen weeks he works beside a specialized worker, usually a veteran To train inspectors, men completing the four weeks training are given an additional two weeks in inspection technique and paper work They are then sent to the inspection department for experience and actual inspection work

United Flying School of America, Vail Field, Los Angeles, claims to have graduated the first girl in the United States to have completed the CAA apprentice instruction course The girl, Miss Jerry Brintnall, started her training while a student at Pasadena Junior College, received her primary course at Nick Lentine Flying Service, El Monte, and both her advanced and apprentice-instructor training at the United Flying School She holds a CAA ground school instructor's license for CAR and teaches CAR at the Pasadena Junior College

Ryan School of Aeronautics has just completed two new two-story buildings adjoining the main office of the school. Each building measures approximately 44 by 85 feet in floor plan. One building will be devoted to flight offices and operations work, and ground school instruction in connection with Army Air Corps flying cadet training work. The other building will be occupied by the expanding Engineering Division of Ryan School, which is conducted by Stanley H Evans, widely known for his engineering work in England and the United States Approximately 120 engineering students can be accommodated in the new quarters

Immediate construction of a $3,000,000 Naval Reserve aviation base on a 480-acre site between Long Beach and Santa Ana, Calif., has been announced. Drainage and runway construction is being started at once and the field is expected to be ready for large scale operations in about 18 months. The new base will be the Navy's largest training center under the new 10,000 pilots per year program

Major C. C. Moseley has announced immediate construction of still another flight training center to be operated by Cal-Aero Academy of Glendale, Calif., which is now operating Army Air Corps flying cadet schools at Glendale, Oxnard, and Ontario The new base will be erected at once on a site near Santa Ana, and will be placed in operation in June, at which time flight training operations now conducted at Glendale will be transferred to the new field The Glendale base is now crowded with Army mechanic trainees, and all available space is needed for this work and for the civilian students of the Curtiss-Wright Technical Institute operated at Glendale by Major Moseley



Vernon Storla, student at Boeing School at Tracy, prepares for a solo flight in the school's Howard

UAL Pilot School

After four months of intensive training, 19 future airline pilots are looking forward to graduation from United Air Lines' new specialized pilot training school at Tracy, California

The 19 men are in the first of three classes, totaling 64, enrolled last fall at the Tracy school, which operates as an adjunct of the company owned Boeing School of Aeronautics One class started in October, the next in November and the third in December Plans call for their graduation in May, June and July, respectively

Those enrolled at United's school are college and university students who have had two or more years of college training with a major in engineering or emphasis on mathematics or physics and who have successfully completed the first and second stages of the CPT program Students who qualify during the first four months at Tracy are transferred to the Boeing School of Aeronautics at Oakland for final instruction in the handling of multi-engined planes Provided they qualify there and pass the strict government and company tests, they are assigned to co-pilot positions with United Air Lines

On entering Tracy, students have an average of 80 hours of flying time under the CPT program. They are given another 150 hours of controlled flight instruction at Tracy and Oakland before they are accepted for airline work. In United's service, they will average 820 hours of flying annually or a total of 33,000 hours of airline piloting at the average retirement age, according to R. T Freng, director of flight operations for United

"Our aim," said Mr Freng, "is to train men to become well-qualified pilots and flight officers thoroughly versed in United Air Lines' high standards of instrument flying, weather analysis, flight planning, radio operation, navigation and all the rest. I am well pleased with results obtained thus far"

E. W Wiggins Airways, Inc., operator at five New England airports, has added several mechanic courses to its training division at the company's Norwood (Mass) base.

Instruction in aircraft woodworking, metal working, fabric and finishing, rigging and maintenance, welding, and aircraft engine repair are being given in new classrooms incorporated in one of the company's five hangars at the field Complete shop equipment has been installed for the sole use of instructors and students

Pratt & Whitney Aircraft has started short courses in drafting at East Hartford to qualify men for its plant Students are paid 50 cents per hour for a 40-hour week and start their work at $120 a month after eight weeks of training

New England Aircraft School moved last month to 395 Maverick St., East Boston, at the Boston Airport The Army School and office remain at 33 Brookline Ave., Boston

Lear Avia is starting a free training course for employees at its new factory at Piqua, Ohio The company has a huge backlog of orders and needs many new workers

SAE Papers

At the recent National Aeronautic Meeting of the Society of Automotive Engineers held in Washington, D. C., some twelve or more technical papers were presented. Although a complete review of all papers may not be printed here, the following abstracts are representative of some of the subjects discussed.

Cooling Characteristics Of Submerged Light Aircraft Engines

H. H. Ellerbrock
Assistant Mechanical Engineer
National Advisory Committee for Aeronautics

An investigation has been started by the NACA to determine the performance of a small airplane with two Continental A 75 air cooled engines enclosed in the wings One of the main problems with engine installations in the wing is the cooling engine The cylinders must be completely baffled and the cooling air quantity reduced to as low a value as possible A low quantity of cooling air is necessary in order that the wing ducts may be small so as to cause little interference with the aerodynamic characteristics of the wing. In normal installations the crankcase and oil pump of the Continental A-75 engine are cooled by air flowing over them but when in the wing no such cooling is possible. This causes the oil to heat up and introduces another problem of providing adequate oil coolers

The Continental A-75 engine used in these tests is a four-cylinder, horizontally opposed piston, air-cooled engine rated 75 brake horsepower at 2,600 r.p.m. with 29 92 in of mercury pressure (dry) and 60 deg. F. Temperature in the intake manifold The bore and stroke are 3⅞ and 3⅝ in., . . . compression ratio is 6 3 The displacement is 171 cu. in. The engines in the projected airplane are to be used as pushers and for that reason the air is introduced to the cylinders from the end of the engine that is normally the rear

One factor that enters into the cooling of an engine that is submerged in the wing that is not encountered in present-day installations is that the crankcase is not cooled by air, as mentioned previously This causes the oil to heat up and the flange temperatures to be too high An external oil cooler of adequate size must be used In the present tests it was necessary to hold the oil temperature to 165 deg F by means of a cooler to obtain satisfactory flange temperatures The oil cooler could be submerged in the wings, in the same manner as the engine, and wing ducts used for cooling.

The shape of the flat engine lends itself readily to the addition of a blower if the latter is needed to obtain satisfactory cooling With the installation arranged as a pusher, a blower can be placed behind the engine in the propeller support A blower of the axial-flow type could be easily designed to obtain efficiencies of at least 75 percent The propeller support would be larger than if just the propeller shaft passed through it but could be faired into the wing. In order to use the blower system efficiently, the cooling air after passing over the cylinders could be used to cool the exhaust pipes before exhausting to the atmosphere. Tests, on the engine showed that the net power, which was the brake power minus the power required by 100 percent efficient blower, remained practically constant as the pressure difference increased If an engine could be cooled satisfactorily, with 500 deg F hottest head temperature, without a blower it would probably be better to use a blower even if its efficiency is 75 percent and obtain the extra cooling which would prolong the life of the engine With a blower with 75 percent efficiency, the net power would be almost as great as without the blower

A major disadvantage of placing the engine in the wing is the impaired engine accessibility The reduction in operating cost, however, will probably be sufficient to give incentive to efforts to overcome this disadvantage One point worth noting at this time is that in the first baffle installation used on the Continental engine in the present tests, the spark plugs were placed under the baffles and no provision was made for removing the plugs without first removing the baffles In subsequent modifications of the baffles a hole was cut in each baffle through which the plug projected, the hole being sealed with a leather patch A few tests were made on the engine with a standard commercial fuel of 78 octane number with the original intake manifolds to compare the performance of the engine with the performance with 100 octane fuel. With wide-open throttle the power decreased approximately 2.5 percent and with part throttle the power remained the same with 78 octane fuel as compared with power with 100 octane fuel The decrease with wide-open throttle was possibly due to a lower volatility and lower heating value of the 78 octane fuel as compared to the 100 octane fuel At part throttle the vaporization of the 78 octane fuel may have been greater, due to lower manifold pressure, than it was with wide-open throttle which would increase the volatility and thus cause the power output to be the same as with 100 octane fuel The use of the lower octane fuel is advantageous in the small airplane due to its lower cost. Although there are many problems to be solved in connection with submerged engine installations the ultimate improvement to be gained more than warrants research on these problems.

Design of Airscoops For Aircraft Carburetors

M. J. Kittler
Chief Engineer, Aircraft Division
Holley Carburetor Co.

Some people concerned with aircraft carburetion problems feel that aircraft carburetors should be designed to work correctly regardless of any installation considerations, and that the design of the airscoop should have no effect on the functioning of the carburetor This would certainly be an ideal condition, but unfortunately, it cannot be completely realized

The carburetor metering characteristics for variations in rate of airflow, for changes in air density, and for changes in air temperature, are determined by the response of the carburetor mechanism to variations in air velocity pressure, and temperature. Anyone who has worked on problems involving the measurement of air flow in ducts has realized the difficulty of obtaining true average values of air velocity, pressure, and temperature . . In this connection, it is interesting to note that insofar as the author is aware, there is no air meter available on the market which will handle the quantities of air handled by a large-size aircraft carburetor . . and read automatically to the limits of accuracy expected of a modern carburetor It would therefore seem reasonable that the carburetor should be supplied with air that is flowing at fairly uniform conditions of velocity pressure, and temperature across the area of the carburetor entrance This,

(Turn to page 138)

Recent Books

The Student Pilot's Training Primer, *By Colonel Hugh J Knerr* Published by D Van Nostrand 250 Fourth Ave, N. Y. City 172 pages, $2

This is the best book on pilot training that has thus far been published It is written by one of the genuine experts in the flying business Col. Knerr has been flying for about 25 years. He was Chief of Staff of the G.H.Q Air Force in the period of its organization He has had a keen interest in pilot training for many years

In his preface he states: " . . . flying ability is no more inherent than the ability to walk Anyone with a normal physical endowment can learn to fly an airplane with safety" He also emphasizes the value of studying flying methods on the ground before taking to the air "Many methods of instruction make the initial error of teaching one to fly by flying As a consequence students frequently are confronted with emergencies requiring coordinated actions which they are totally unfitted to perform"

An outstanding asset of the book is the simple manner in which the use of airplane controls is discussed A student who masters this material thoroughly will have gone a long way in his instruction The book is filled with advice and wisdom which this reviewer has found in no other book on piloting The excellent illustrations make a considerable contribution to the text. In short, here is a book that will help any student pilot as well as any flight instructor with his job

Aircraft Instruments their theory function and use *by Orson Edward Patton* Published by D Van Nostrand Co New York 220 pages $2 75

The author is an aircraft instrument technician and instructor in the Air Corps, as well as chief instructor at the Harrisburg Evening School and the Pittsburgh Institute of Aeronautics He has written an excellent book for students and mechanics who wish to understand the fundamentals of instrument operation

Chapters of the book are as follows: compasses, altimeters, rate of climb and accelerometer indicators, air and ground speed indicators, time pieces, electrical indicating systems, temperature gauges oxygen regulating systems, pressure and suction gauges, tachometers, instrument installation and illumination systems, fuel-quantity and fuel-flow gauges pumps The book is illustrated with over 200 excellent photographs

Focus on Africa, *by Richard Upjohn Light* Published by the American Geographical Society, New York 228 pages, $5

Here is a book that will make both pilots and amateur photographers green with envy In 1937–38 Dr Light and his wife flew their Bellanca from Michigan down through Central and South America and then took a steamer to Cape Town This book is the story of their flight from the southern tip of Africa up to Cairo and then across to Corsica If we were giving a prize for the best travel book of the year this would easily win first place

The book will appeal to pilots because it describes the kind of trip that all pilots dream about To photographers the appeal will be in the beautiful aerial shots made by Mary Light, who could certainly help to sell air travel in America if she turned out even half as interesting a group of photographs taken along our airways

Dr Light who is well known among private pilots for his flights to many parts of the world, was not just another pilot on a junket His text is filled with intelligent observations and packed with interesting information on the countries of Africa through which he flew

Youth in Aviation, an Air Youth Manual for Leaders Published for Air Youth of America by D Appleton-Century, N Y 266 pp $2 50

Germany has received considerable praise for her far-sightedness in making Nazi youth air-minded It is generally recognized that Nazi strength in the air today is partially due to its long-time program of air-conditioning its boys and young men In this country Air Youth of America has the only comprehensive plan for putting to good use the tremendous interest our youth has in aviation The program is not only wise education but commendable for national defense

Air Youth's new book is the best volume for leaders that has yet appeared It's 26 chapters are packed with practical advice for men who are to lead groups of boys in model building and in soaring There are many handsome photographs and clear drawings The book is a valuable contribution to aviation literature

All American Aircraft *by Ernest K Gann* Published by Thomas Y. Crowell Co. New York 122 pages, $2

The author begins by saying "These are the champions Each airplane in this book has won its place because it is literally an All American. Each ship is the outstanding one of its class and type" There may be some disagreement about that but there won't be on the fact that this is a collection of beautiful airplane photographs The accompanying text is fresh and to the point Over 50 airplanes of all types are pictured and discussed

Wings of Victory, *by Ivor Halstead* Published by E P Dutton, New York 221 pages, $2 50

This is a story of the R.A F from the beginning of the war through the events of last November It is an exciting, fascinating story of R A F. pilots and their heroic defense of Britain It contains many new stories and episodes that have not been printed before and many fine illustrations The famous, "Airman's Letter to His Mother" is reprinted, as well as Charles Gardner's BBC broadcast of an attack on convoys which he saw J B Priestly has written an epilogue which is a moving tribute to R A F pilots

Their Finest Hour, first-hand narratives of the war in England, edited by *Allan A Michie* and *Walter Graebner* Harcourt Brace & Co N. Y. 226 pp., $2 50

Life's London correspondents, Allan Michie and Walter Graebner, present a collection of personal experiences of individuals actually engaged in the Battle of Britain This matter-of-fact, first-hand account by men and women who have participated in the battle of Dunkirk R.A F raids, submarine attacks fire-fighting in London, bombings hospital service during raids, convoy battles, is a saga of courage, skill, and endurance It gives a graphic picture of the nightmare war in England as it is being fought by combatants and civilians No official communiques "eye-witness" accounts or newspaper reports can bring home as vivid a realization of the struggle being waged as do these tales,—simply told unemotional, heightened only by the "I" of their telling and the excellent photographs. If this is a cross-section of the spirit of the British people, it is not difficult to believe that theirs will be the victory

Training New and Prospective Foremen, published by the Elliott Service Co, 219 East 44th Street, New York City

Elliott Service was founded in 1911 and since that time has made many important contributions to industrial education and training It provided

SPECIAL TOOLS FOR THE AIRCRAFT INDUSTRY

three services a weekly bulletin for department heads, supervisors and foremen, a complete plan of bulletin board publicity, and a suggestion service. Because of recent inquiries *Aviation* has received concerning foremen training, this brief mention is made of the training facilities offered by Elliott along this line The company issues a number of valuable booklets with its service, including management information, your job today, how to instruct, how to manage, how to correct workers, how to handle grievances, qualities of a good boss, labor relations check guide and many others Cost of the service varies with quantities ordered but seems to be low

FLIGHT, by *Capt Bailey Wright, James J Smiley Jr* and *Rex Martin* Published by American Technical Society, Chicago 283 pages, and 259 pages

Two books have been issued in this series the first on aerodynamics and flight and the second on construction and maintenance The first provides a general knowledge of flight and serves as a foundation book for further study There is considerable aerodynamics material and a chapter on soaring and one on parachutes, with a list of quiz questions

The second book has the following chapter headings blueprint reading, woods used in airplane construction, metallurgy, welding, construction, rigging, repair, propellers, quiz questions Both books are written clearly and simply and make good textbooks for beginning students

KEEPING AHEAD OF THE WEATHER by *Peter E Kraght* Published for Associated Aviation Underwriters 90 John St, New York, N Y 63 pages Price $1 15

Airmen will find this pocket-size booklet of particular value to them whether they are student pilots, private pilots, or transport pilots

Concisely and accurately written by a graduate of California Institute of Technology, it is illustrated throughout by sketches and photographs of weather and cloud formations The booklet contains eight sections, the first seven of which discuss different aspects of weather The last chapter is devoted to explanations of U S Weather Bureau circuits and the meaning, sequence and schedules of transmissions on these teletype circuits

Mr Kraght, an American Airlines' meteorologist, makes available in his readable handbook certain basic information necessary in order that the pilot may talk intelligently with the forecaster and to be in a position to read reports for himself Student pilots will find Section VIII especially interesting in preparing for license examinations

WINGS FOR CAROL, by *Patricia O'Malley* The Greystone Press, New York, N. Y , $2.

A refreshing interlude in an aeronautical book-reviewer's day is to browse through Patricia O'Malley's book "Wings for Carol" Rather neatly, we think, Pat balances the flock of aviation books for boys by turning one out for the neglected distaff side. The younger generation is very vocational minded, takes its training seriously, and is eager for any information that will give it an overall picture of a chosen field This Miss O'Malley's book does for girls whose eye-appeal makes them potential airline hostesses She skillfully weaves the requirements, the schooling, the routine, the duties, and the life of a stewardess into an interesting story, including in it some of the promotional work and functions of an airlines' publicity department. Beginning with their graduation as registered nurses, Carol and Foster go through each step in the training of hostesses, and have many interesting experiences after they have received their wings

THE 1941 MODERN PLASTICS CATALOG Breskin Publishing Corp, 122 E 42nd St, New York, N Y 467 pages, $3 50

Published for the first time in book form the new 1941 Modern Plastics Catalog is a treatise on the plastics industry It is profusely illustrated and organized to make the finding of specific information an easy task. Here is a work that should be of great value to the increasing number of people in industry and commerce who are seeking information about plastics

The book is organized in nine main divisions The first, Plastics Engineering, is introduced for the first time and contains flow sheets that show the manufacturing procedure used for various plastic materials Among other divisions the Materials section treats of all types of plastics according to their composition Written by an expert, each treatise covers all new developments and applications during the last year

A feature of the book is the Plastics Properties Chart, which again appears, completely revised where required through improvement or change in the raw material involved This chart has become standard reference in the plastics industry Two other charts appear this year, also one on Solvents the other on Plasticizers Each chart should be of great interest to raw materials manufacturers and molders

Simonds on Plastics

(Continued from page 38)

classified as mechanical This is the blade shank chafing rings used in the Hamilton hydromatic propellers These rings are molded from phenolic plastic material and mounted between the inner bearing race and the blade butt as illustrated in Fig 4 The purpose of the rings is to alleviate stress concentrations set up in the blade shank due to contact with the blade thrust race They also prevent the gaskets used in sealing this part of the hub from chafing the shank of the blade itself, and in addition provide improved sealing surfaces The factors influencing the choice of this type of plastic for this application were its imperviousness to lubricants, cushioning effect and its non-abrasiveness

Airplane Interiors

Getting back to aircraft interiors what is believed to be the first all plastic instrument panel, Fig 5, is now used as standard on Aeronca planes of the Aeronautical Corp of America The primary considerations influencing this application were light weight and dimensional stability The material selected to meet these, and other considerations was the polystyrene type from the thermoplastic family This material stands number one on the long list of plastics for low specific gravity, high electrical values and low moisture absorption Other considerations, according to the manufacturer, were light fastness of color and machinability, to permit panel alterations for installation of additional instruments

The use of transparent plastics for pilot cockpit inclosures, wind shields and other points for observation, has become universal, with the choice of materials used ranging from cellulose nitrate, through cellulose-acetate and vinyl to methyl methacrylate. For military and transport planes the methylmethacrylate type of plastic material is generally specified because of certain inherent optical properties of higher values than comparable properties found in other types of transparent plastics Though not possessing the hardness and resistance to abrasion of glass, methylmethacrylate materials possess optical properties equivalent to the finest quartz crystal and in addition has a low specific gravity and relatively high resistance to impact (6) A typical inclosure of methylmethacrylate is the bombardier's compartment, the turret and the tail-gun compartment of the Martin bomber, shown in Fig 6. In the Boeing Flying Fortress, extensive use is made of this type of plastic in the gun positions on sides, top and bottom of the fuselage See page 40 for additional photographs of this plastic

Plastics for Structural Members

From time to time one reads or hears of a new "plastic" plane design. The unqualified use of the term "plastic" in describing these planes has, in some instances regrettably developed some wrong impressions Right here the writer wishes to reiterate his previously recorded, and oft repeated admonition that a more accurate designation of such planes would describe them as *reinforced plastic* planes (7), (8), (9), (10) The more recent developments in reinforced plastics as materials for aircraft structural members, such as fuselage, wings, and tail units, are attracting considerable interest and attention Collectively, these pioneering developments are adding impetus to the trend toward molded reinforced planes and already several plane manufacturers are either in active production on such planes, or intensifying their experimental development work in this direction

The Glenn L. Martin Co has established a fellowship at the Mellon Institute for research on the problems involved Another group engaged in similar work is the Plastics Section of the U S Bureau of Standards, under the sponsorship of the NACA It is believed that the technical data gathered by these two groups will be made available to the industry as compiled

In practically all of the development and production applications of plastics to aircraft structures, thin wood veneers are used as the reinforcing agent for the synthetic resins, the latter being usually of the urea and phenolic types from the thermosetting family Variations, naturally, are to be found in the means and techniques employed in molding the members, this being dictated by a matter of individual preference, and yet the fundamentals embodied in the individual processes are common to all Fundamentally, the procedure embodies the coating of the veneers with a liquid resin or interposing a resin film between the veneer strips, placing the resin treated veneers in a mold or form until the required thickness of lamination is obtained, means to hold the veneers in place under pressure, and subjecting the entire built-up assembly to heat until the resin forms an infusible bond between the veneers

The Duramold fuselage illustrated in Fig 7 is a good example of a completely molded structure without metal reinforcements of any nature. This fuselage is 19 ft long, 5½ ft in diameter at the cabin end, and is molded in two halves from wood veneers ranging from 1/48 in to 1/20 in in thickness with .003 in phenolic type film as the veneer bonding media The specific gravity of this structure is 0.52 In the Duramold process, the mold or form with the veneers and resin films in place is put in a tightly sealed tank (Fig 8 shows a 10x31 in. tank being installed) of special construction where the curing heat is applied and, through unique and ingenious methods, a uniformly distributed pressure is applied and maintained on all contours of the fuselage.

The Timm plane shown on page 40 is completely molded from resin coated wood veneers, both the urea and the phenolic types being used as the bonding media At this writing no details are available on the fabricating means or techniques employed by this manufacturer

Molded aircraft structures present many advantages (11), (12), (13), proven and potential, one of no little importance being the possibility of forming, without weight penalty, the designer's dream of a strong, durable and almost flawless aerodynamically perfect surface as opposed to the conventional riveted metal plate surface (14)

Two very new applications of reinforced plastics have recently been announced by the Glenn L Martin Co, one being applicable to any type of plane, the other designed essentially for combat planes The laminated trim tab was developed for use on ailerons, elevators and rudders. The primary object of tabs is to relieve the pilot of continuous manual effort in maintaining them in their proper position, relative to the surface to which they are attached, during normal flight conditions These tabs are adjustable from the pilot cockpit to any fixed position required to balance the plane for various flight conditions, such as climbing, cruising and gliding The tab shown is fabricated from laminated fabric impregnated with liquid phenolic resin These tabs are somewhat lighter than their metal counterparts and, unlike metal tabs, there are no projecting rivets or lapped joints The internal bulkhead construction embodies resin impregnated fiber which adds to the rigidity of the outer surfaces and provides the means for the attachment of the control hardware. Incidentally, this tab was awarded top honors in the Transportation Group of the 1940 *Modern Plastic* competition

The bomb-bay doors of Martin bombers are substantially hollow shells having resin bonded plywood covers and poplar framing They are 14 ft. long and weigh 41 lb. less the hardware.

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Decat on Plastics

(Continued from page 41)

in your telephone or your car panel It would be so simple to build a press which at each molding would make a complete wing or fuselage. The answer lies in the fact that bakelite to be molded in powdered form, requires a very high pressure and a press to handle any such mold has so far not been made Molds for any such plane would run into many hundreds of thousands of dollars, a prohibitive cost at the present aircraft production level

Present Developments

The Glenn L. Martin Co set the pace in *fabric* laminated phenolic plastic with a tab made by Taylor Fibre Co., composed of different laminations of fabric impregnated with phenol formaldehyde and formed in a hardened steel mold heated at about 300 deg F with a pressure of at least 2,000 lb per sq in It is cured under pressure and heated for several minutes, depending on the thickness of the part to be polymerized No finishing is required when it is removed from the mold Some metal parts can also be molded while the piece is in the mold

The reason other companies have not used this laminated phenolic plastic more frequently lies in the initial cost of the die and the fairly high cost of the lamination itself

The outstanding properties of laminated phenolic plastic are its dimensional stability, its acid, chemical and water resistance Although it has a great electrical insulating quality, this quality is not taken advantage of in the tab construction

Martin also used laminated plastic-bonded wood in a long bomb day door made by Bender Aircraft. Though not much information is available as to their process, it seems to be in the same trend as those of other manufacturers

One manufacturer uses an inside mold which he subdivided in small parts In molding a wing, a jig is made for all the ribs On this jig two or more laminations are laid with urea formaldehyde or polimlester in between The jigs are placed in a rubber bag from which all air is withdrawn This bag acts as a clamp on top of every wood lamination and curves it to any shape the mold might have The molds and ribs are then laid one after another on the spars which are made by almost the same process These are again placed in the bag for gluing and finally the stressed skin, which is made of 3 1/45 in mahogany lamination, is laid on top of the ribs and spars, which are placed in the rubber bag Air is withdrawn and the bag is placed in an auto clave in which a pressure of 80 to 100 lb is applied while the mold is raised to a temperature of about 200 deg F, depending on the type of resin used

Another process is based on an outside mold made of iron, the countermold being also a rubber bag. The glue used is phenol formaldehyde which at first was the only one that endured boiling once it was set The mold is self-heating in the sense that pipes have been laid inside so as to be able to apply the full steam, and thus cure easily the phenol which has set at around 300 deg F Though the iron mold was used for the Fairchild 46, its cost was so great that now it has been replaced by a cheaper mold made either of wood or of a lighter metallic material The advantage of this process is that as the mold is outside, the pieces come out with a perfect finish, whereas in the process in which the outer surface is in contact with the rubber, the inside comes out of the mold smooth but the outer surface has to be smoothed down In this latter process there is the advantage that once the mold is established, any rubber bag bigger than the mold can take care of it, the only restriction being the pressure tank. In the former process, each mold requires its special rubber bag

Timm Aircraft Corp has released very little information regarding its plastic process Timm apparently uses an inside mold of the desired shape lays on top all the different layers of spruce which have been cut to the desired shape and impregnated with resin These are superimposed on top of one another, cured and then assembled on a frame made beforehand. The curing is done under dry heat in a big oven 10x10x40 ft which can hold a wing fuselage and tab at the same time The only drawback in the assembly of Aeromold is that, contrary to other processes which have — depending on the kind of glue they use — a margin of several hours for the setting of their glue line, Aeromold has to cure in the oven at least an hour after applying the glue The resin seems to be about half-way between a cold setting and a hot-setting resin, allowing the final curing to be done at a temperature under 200 deg F See Fig 9, page 40

Still another method used in this country consists of two layers of plywood with a layer of cork sandwiched between The advantage of this process over the other is the total absence of spars or ribs allowing an entire stressed skin for wing or fuselage To reinforce the cork a thin wire mesh is laid in the middle The mold is made of a thin metal skin stressed on the airplane principle, with beating tube coming in contact. The countermold is made of a rubber bag of the shape of the inside The whole wing is made at one time of a single piece including the leading edge reinforcement The resin used is hot-setting phenol formaldehyde The wing comes out of the mold highly polished and needs only to be closed at the trailing edge. A three-ply spruce veneer is used on both sides So far, only a small wing part 3 ft. long has been produced It was able to withstand the weight of five men

The Atfield plane, of which little has been heard lately, is also a plastic type, though the plastic used is of the cellulose nitrate type. The plane is of geodetic construction and the setting is done at room temperature. A frame rather than a mold is used, and the strips of wood are interwoven

The same kind of construction is used in the Plexweve airplane made by the Plexweve Aircraft Corp

Bowlus, the manufacturer of sail planes, is worth mentioning Taking advantage of a Lockheed development made some years ago, Bowlus starts with a concrete mold made in the shape of half a nacelle For the sailplane, all layers are deposited in proper order and well coated with resin glue A rubber bag is placed on top, the mold closed with a wooden frame and the veneer compressed into shape.

Other experiments have been conducted in the cold-setting type of resin The molds primarily were made of wood, but Catalin Corp's phenolic resin mold is now being used in which both male and female dies have been made. Between the layers of wood there is spread a cold-setting phenol glue, and to accelerate the setting the mold and layer is heated lightly up to about 180 deg F in a kind of kiln in which the moisture content is thoroughly controlled so that the wood does not "lose its life", i e, lose its moisture and crack

All these processes deal with wood impregnated or not set under heat. However, various developments have been conducted under different names superpressed, compressed, improved wood, densewood, etc In other words, the wood is given not only a chemical treatment but is mechanically treated as well The pressure varies from 500 lb to 3,000 lb per sq in, which pressure is governed so as to avoid splitting the wood under pressure or springback once the pressure is relieved. The wood which has been thus compressed and chemically treated results in a material that is heavier than water with a density over 1 00

Under the "Schwartz process" a

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Decat on Plastics

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thick layer of wood of about 1 in or more is impregnated and compressed so as to increase its tensile strength up to about 35,000 lb per sq in These laminations are scarfed and bonded with a special glue to a plank of the same thickness made of ordinary aviation spruce Once glued they are piled up and bonded under light pressure between 100 and 150 lb. As soon as this block, which has a hard scarfed shank and a light tip, is set it is profiled on a profiling machine, the shank threaded and screwed to a metal hub, and glue is injected in all the spaces between the metal and wood. Next a sheet of cellulose acetate is glued under heat and pressure after having been plasticized on both sides of the blade, protecting the blade from any moisture content change See Figs 1–3, pg 39

Airsealand Aircraft Research Co, working on the Decat process, make a propeller starting with very thin, partially impregnated, laminations, forming a variable density wood controlled exactly all along the blade. The laminations are squeezed in a mold bearing the shape of the blade which is heated under pressures ranging up to 3,000 lb After the curing of the phenol resin in the mold, the blade comes out completely finished with a shank having a density of 1.4 and the blade of even lower density Heating is done by an ultra high frequency machine to reduce time and to obtain a thorough inside curing The blade is then impregnated outside with a special thick phenol formaldehyde layer which prevents changes of inside moisture content and is at the same time tough. The tensile strength of the material at the shank is the same as that of aluminum.

There is still a whole range of plastic materials using wood as a base developed by such companies as Airsealand of which full advantage has not been taken All those superpressed or compressed woods are ideal for airplane spars and all parts where lightness and strength are needed. Due to its high compression ratio it was also extensively used in Europe for production tooling and the pressing or stamping of light metal parts

Although in Europe many plastic airplanes have been made, not to mention motor cycles and entire fenders for cars, the U. S is well on the way, and every day more companies are switching to plastic for cheapness in design layout, mold production, ease of getting raw material, high finish, increased efficiency, lightness, and ease of repair.

With all these processes it is easier to make streamlined, or curved, rather than flat surfaces, and monocoque structure is easier to mold than any other type of construction Of course the external part of the plane is jointless and rivetless, increasing the efficiency by at least 10 percent. Compound curves, which have always been a dread to the seaplane engineer, are easy to produce, and with a proper impregnation of the wood no deterioration results from salt water action.

Another Plastic Design

The Columbia Airplane Company is constructing a new plastic airplane model The plane is to be a four-place, low wing monoplane, powered by two 65 hp, four cylinder Franklin engines, one located in each wing This plane is being jointly constructed in the Hangar of H S Morgan and the Purdy Boat Company, both of Port Washington, Long Island The wooden formers are shaped in the Purdy plant and moved to the Morgan Hangar for actual construction of the plane

The basic material used in building this plane is mahogany $\frac{1}{16}$ of an inch thick which has been treated with an adhesive At points of strain, bulk heads and beams are used to give additional strength to the shell-like design

The first step in building is the shaping of full size wooden replicas of the various parts of the plane These sections are made from hard wood and cut and smoothed to the exact dimensions of the finished product They must be made in half sections to facilitate the removal of the plastic shell after heating The second step exists in the actual molding of the mahogany out of which the plane is made This mahogany, with the adhesive added, is shaped roughly around the wooden former and fastened down Then both mahogany and former are placed in a large rubber bag about the thickness of an inner tube, and the air is then withdrawn from it This entire mass is placed in a compressor at 60 lb pressure per square inch, and heated to a high temperature With the absence of air, the pressure of the rubber bag against the mahogany, and the heat, a reaction takes place with the adhesive in the mahogany As the air in the compressor is cooled, keeping pressure constant, the shape of the wooden former is retained in the mahogany This process is repeated with the correspondingly opposite section and then the two are fastened together All parts are constructed the same way The fuselage is reinforced with bulkheads that are moulded into the sides during the formation period "I" beams in the wings are similarly constructed The process was developed three years ago and is now in use

Simonds on Plastics

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Under load test up to 150 p.s.i they show no buckling of the plywood cover and the deflection measured under maximum test load was approximately one third of the metal counter part of same weight The plywood cover consists of $\frac{1}{8}$ in plywood having mahogany surfaces and poplar core, bonded with phenolic resin Ribs are made from 15 laminations of $\frac{1}{8}$ in poplar bonded with cold setting urea resin.

A brief look backward at the structural materials employed in the aircraft of earlier days, reveals the universal acceptance of wood as the structural material for the "skeleton" of all planes Since those days the aircraft industry has come a long way in finding and utilizing other useful and durable structural materials In view of the current trends one may well be tempted to ask the interesting question—are synthetic plastics leading us "back to the woods"?

[1] See the *Journal of the Aeronautical Sciences*, Vol 5 No. 2, December 1937 pp 37 52 "Propellers for Aircraft Engines of High Power Output" by Frank W Caldwell

[2] See SAE Transactions, Vol 33, July, 1938, pp 293 300 'Aerodynamic Considerations Affecting Propellers for Large Aircraft Engines'' by George W Brady

[3] See SAE Transactions, Vol 33 July 1938 pp 289 292 "Propeller Factors Tending To Limit Aircraft Engine Powers,' by G T Lampton

[4] See SAE Transactions, Vol 33 July 1938 pp 285 288, 300 Propeller Problems Imposed by Substratosphere Flight Requirements,' by Carl T Baker

[5] See SAE Jrl June, 1939 "Composite Wood and Plastic Propeller Blades by Fred E Weick

[6] See NACA Tech Note #718—"Resistance of Transparent Plastics to Impact.' By Benj M Axilrod and Gordon M Kline.

[7] See Modern Plastics—Vol 7, No 11—page 25 31 78 80 82—'Molded Airplanes for Defense"

[8] See Aero Digest, July 1939—"Low Density Structural Materials by Col V E. Clark

[9] Forest Products Laboratory U S Dept Agriculture Madison Wisc., 'Contributions of Synthetic Resins to Improvement of Plywood Properties' by Don Brouse

[10] Modern Plastics—Sept 1939, 'Structural Considerations Favoring Plastics in Aircraft Structures, by Charles F Marschner

[11] Aero Digest—July 1939, "Plywood Structures" by O H Basquin

[12] Aircraft Production, Dec 1938 "New Structural Materials,' by A H Tillman and A E. Elliston

[13] Royal Aeronautical Soc Jrl. Vol 42 pp 963 1013—Nov 1938, 'Materials for Aircraft Construction,' by H J Gough.

[14] E A E Jrl Vol 44 No 6 page 258, "The Effects of Rivets and Surface Roughness on Wing Drag" by Manley J Hood—NACA


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North Atlantic Ferry

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interesting In Montreal I was greeted by Capt A S Wilcockson, well known for his work with the Mayo composite plane, who was in charge of the Air Division of the Canadian Pacific Ry. Co He told me that I was the second American to volunteer, the first having been a young pilot who had gained most of his flying experience in Central America Others to join our little group included Hal Sweet, Penny Rogers, Earl Ortman, and many more.

Although I had joined up in August, it was late September before we got our preliminary flying program organized Two Lockheed Hudsons arrived, all fitted up as check planes to test the instrument flying abilities of the various volunteers These tests were under the supervision of D C T Bennett, flying superintendent of the air division, who later led the first formation flight across Those of us who passed the tests were given contracts Pilots received $1,000 per month, co-pilots or first officers, $800 per month The crew was completed by a radio operator who was paid $600 a month I was appointed a captain and assigned a crew. Part of the duties of each crew was to conduct a thorough test flight program with each bomber prior to the actual ferry flight, carefully checking engine power and fuel consumption

The Lockheed Hudson, a military version of the Lockheed Model 14 transport, is well known As delivered in Canada they are already marked with RAF insignia, and are camouflaged for service over Europe. Powered with two Wright GR1820-G205A Cyclones the Hudsons have a normal gross weight rating of 18,500 lb. However, with additional gas load, extra equipment, and spare parts carried across they were overloaded to a gross of 21,500 lb Total fuel capacity was about 1,050 gal, and 36 gal of oil Radio equipment was Bendix, one transmitter and two receivers, with loop direction finder Instrument equipment is standard and includes an automatic pilot. Celestial navigation equipment was provided for the lead plane of the squadron only Actual navigation was done chiefly by dead reckoning, figuring known and estimated winds along the course as determined from weather maps based on such information as could be obtained prior to each flight Pan-American Airways allows an error of 30 mi in 1,000 mi when flying by dead reckoning On my first ferry trip I was off just about 45 mi in 2,100

In addition to standard equipment, the Hudson is fitted with a collapsible rubber lifeboat built into the cabin door in such a way that it is released automatically if the plane is forced down on the ocean These lifeboats are inflated from air bottles and are equipped with emergency water and food rations, and with signal flares

Goodrich de-icers are mounted on the leading edges of wings and control surfaces of the Hudson In addition an ice resistant compound known as Kilfrost was smeared over the de-icers and all leading edges Kilfrost has a very definite time limitation, but up to five or six hours it will cause ice to break away after forming The combination of de-icers and Kilfrost worked perfectly under all icing conditions which I experienced, but I do not think this could be counted on under bad icing conditions for longer than 5 or 6 hr

Since only sufficient fuel capacity is provided in the Hudson to allow a comfortable margin for the flight, it is quite important that consumption be closely controlled Use of power was limited to the minimum efficient horsepower per engine on the actual ferry hop This was calculated in advance to fractions of a horsepower, varying with decreasing fuel load, to achieve optimum fuel consumption Each plane was put through a thorough flight test program in Canada, under simulated trans-Atlantic load conditions, to determine actual fuel consumption precisely I made one test run of about 900 mi, at an indicated air speed of 135 m p h, at altitudes of 7-11,000 ft., and established a fuel consumption of 67 gal per hr On another test run I climbed to 9,000 ft with a crew of three in the plane and established an average consumption of 66 gal per hour for a flight lasting 4 hr and 7 min Indicated air speed at level flight cruising was 137 5 nautical m p h, and true air speed 157 nautical m p h Later I found that the actual fuel consumption of the first ferry trip was at the rate of 73 5 gal per hr, with a land-to-land ground speed of 204 nautical m p h The high speed of the trip, considering the low power at which the engines were operated, resulted partially from favoring winds and also due to the altitude of 16-18,000 ft. at which most of the trip was flown Block-to-block ground speed was only 185 nautical m p h, due to a delay of about an hour after making my landfall in the British Isles. This delay was chiefly caused by local storm conditions which made it difficult for us to orient ourselves for the final approach to our assigned terminal field

After completion of flight tests in the vicinity of Montreal, I was ordered to proceed to Newfoundland and await start of the first Atlantic delivery flight The trip from Montreal to Newfoundland, about 900 mi., was made nonstop and by dead reckoning navigation to simulate trans-oceanic conditions We carried a full load of fuel and made the trip without benefit of radio Three planes made the flight in formation, arriving in good order at a barren but well equipped base near the Newfoundland coast

After two weeks of waiting we received word from Montreal on the morning of Nov 10 that Bennett, our flight superintendent, would arrive in the early afternoon to lead our formation across to England that same evening We now had our entire group of seven planes on the line and ready for the trip The rest of the day was spent in a minute check of all equipment. Parachutes and life preservers were carefully readied Emergency rations were inspected and stowed away, consisting of several gallons of water, half a dozen cans of beef and half a dozen tins of chocolate The emergency lifeboats previously described were examined, along with Very pistols and signal flares But no fire arms were given out as we were not supposed to fight, even if we ran into trouble. Since we were civilian pilots we wore no uniform of any kind

Bennett landed in the early afternoon and called a conference of the flight captains He had complete weather reports from stations in Canada, Ireland and England, and the weather bureau at our Newfoundland base prepared a detailed weather map and forecast of conditions along the proposed route Each captain was provided with a small folder carrying a sketchy copy of this weather map and the report of known and estimated wind conditions From this information Bennett prepared a flight plan which covered every conceivable contingency We were to fly a great-circle course If we entered instrument flying conditions we were to break formation according to a prearranged plan and continue on our own. Up to a pre-determined point, about 4½ hr out, each Captain was to decide whether to continue the trip or turn back, depending on conditions After passing that point we were required to continue in any case. When he had completed his explanation of our flight procedure none of the captains had either suggestions or criticisms to offer We were ready for the take-off

We were a pre-occupied group at dinner, 21 of us scheduled to undertake the experiment which would determine whether or not American bombers were to be delivered thereafter by mass formation flights There were four American crews and three British The Brit-

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North Atlantic Ferry

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ishers seemed cool as cucumbers, but I think most of the Americans shared my own feeling of tension. I felt very much "on the spot". These British people had hired us to do a job of delivering their much needed airplanes for them. We were the "fair-haired" boys on whom they counted to deliver the goods. There wasn't much time or inclination to think of ourselves as "carrying the torch of liberty" but I do know that I felt a responsibility to uphold the honor and traditions of American pilots in general. Already there had been quite a few American volunteer pilots rejected after a flight test punctured their exaggerated claims of flying experience. And there had been some grumbling among the Canadians about these American pilots with padded log books.

At a little before 7 p.m. I collected my crew and climbed into the plane. Mine was number six in the seven-plane formation, last on the right leg of the Vee formation. On the dot at 7:30 Bennett moved down the runway in the lead plane, his lights reflecting back from the snow piled along the runway. His plane lifted slowly after traveling two-thirds the length of the mile-long runway, and disappeared into the night. The other four planes ahead of me took off in rapid succession and soon it was my turn. There was nothing unusual about the take-off and, as visibility was good, we easily located the running lights of the other planes and were soon in position in the formation.

We reached an altitude of 9,000 ft., which we held for the first leg of the flight in order to gain the benefit of favoring winds, and also to top a thick cloud layer which hid the Atlantic as far as we could see. The moon rose and shimmered across the sea of clouds. The air was calm and clear and our plane behaved perfectly. We all followed the leader and let him do the navigating. It was an auspicious start for the flight.

Although we had interplane radio communication and were permitted to use it at this stage of the flight, there was little occasion for its use. We had agreed in advance on a plan of procedure if weather conditions forced us to break formation. Each captain was to turn off course a prescribed distance and then proceed to his destination on his own. A median point had been established in advance, at about 4½ hr. out, beyond which all planes were to proceed to England. As mentioned earlier, if trouble developed prior to reaching that point the plane in trouble was to return to the take-off field.

After a few hours of comparatively good flying weather we found the cloud formations extending up into our path and we were soon in an active storm area. This storm had been charted on our flight map and we climbed to 16,000 ft. in an attempt to get over it, but without success. Shortly we all plunged into rain and black storm clouds. We began bouncing around in lively fashion and I decided at once to turn off course. We flew due South for 20 min., then turned back on course, allowing a few degrees for the deviation from the original flight plan. Within a few minutes after breaking formation we began to pick up a load of ice. Already I was feeling the effects of the altitude and my first officer, as mentioned earlier, was completely incapacitated by now. To get rid of the ice I had climbed rapidly to 18,000 ft. and we soon were free of the worst of it, though the storm continued unabated. It was reasonably warm inside the cabin, but the outside temperature had dropped to —23 deg. C. Our oxygen equipment was not elaborate and, what with the storm and darkness, I did not try going any higher, but held level at 18,000 ft. for the remainder of the flight until time to let down. Our weather map had indicated that we would be in the storm area for about an hour but it actually extended almost all the rest of the way across. Several low pressure areas had apparently jammed up together into one big disturbance and we droned along through the "soup" at 18,000 ft. for hour after hour. Presently one of the engines began to roughen up and drop a few revs. Probably it was icing trouble as it soon steadied down to work again and did not bother us further.

At this stage of the flight my mind, like the engine, was skipping a beat occasionally. I supplemented my breathing by drawing on the oxygen bottle and managed to keep fairly clear-headed. What worried me most was the behavior of the automatic pilot. The wing would dip in the rough air and then come up very slowly. I studied the instruments for some clue to this performance, afraid to trust my own senses against the automatic pilot, and noted that the oil pressure for the automatic pilot was low. I reached over and disengaged the automatic pilot and flew manually for about an hour. As I disengaged the pilot the hydraulic pressure gage, which should have read 100, was wavering around 35. Since the servo motor is operated by this hydraulic pressure it was obvious that the low pressure was responsible for the sluggishness of the controls. Doubtless due to faulty maintenance some foreign matter in the hydraulic system had been causing valve leakage and consequent reduction of pressure. Permitting the hydraulic system to idle for a period seemed to solve the difficulty for after I re-engaged the control there was no more trouble from that source.

After carefully refiguring my course and allowing for estimated winds I reset my time of arrival, moving it up by 30 min., and when 1 hr. from my destination I began to let down. It was still soupy weather and black as pitch but at about 11,000 ft. we broke out between two layers of clouds and could see faint daylight beginning to break ahead of us. We continued down until at 8,000 ft. the ocean was visible below us. I continued at this altitude for half an hour, keeping close to the cloud layer above me just in case those imaginary Messerschmitts should materialize. At 0806 Greenwich Mean Time I spotted a dark shadow on the water which soon turned out to be an island. We had made landfall 15 min. ahead of schedule.

We circled the island in an attempt to identify it and fix our position on the map. At this point a plane came out of the storm and after a few anxious moments I identified it as Bennett's ship, which later proved correct, as he reported making his landfall at about the same time and place as I had, but before I could intercept him he had plunged into another cloud bank and was gone.

The area was full of local rain squalls making visibility bad. I finally dropped down to an altitude of 1,000 ft. but it was still impossible to identify our position with certainty. At this point a wing tank ran dry, and, as I switched over, I noticed that the master fuel gage for all wing tanks was not functioning at all. There was another 100 gal. in the fuselage tanks, but how much more I could not be sure. With fuel beginning to run low I decided to use emergency procedure and ask for a radio bearing, although we were under strict orders to avoid this if possible.

My radio operator soon got a bearing but it didn't fit my idea of our location and I asked for a confirmation. But when my operator tried to reach the station again they refused to answer. After circling the island for 45 min., with fuel running dangerously low, I authorized the sending of a "priority" message, which demands immediate attention. This got us a proper bearing in short order and we flew on to our destination without further delay. However, I heard a great deal about this priority message later as it stirred up quite a protest in British radio circles. Apparently they differed considerably from my own estimate of the

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North Atlantic Ferry

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importance of landing the bomber in good and serviceable condition on British soil. I could have made a precautionary landing on most any piece of pasture land, but would have run the danger of damaging the plane.

As I approached my destination it was necessary to fly across a small land-locked harbor at fairly low altitude, due to a combination of high hills and a low cloud bank. We had been instructed to let down our landing gear and fly below 1,000 ft. when crossing settled areas, in order to keep from being shot down by anti-aircraft gun crews. So I had the gear down as we approached the harbor, but even so spent several anxious minutes as a patrol boat in the harbor trained its guns on us. We dropped even lower, throttled back the engines as much as I dared, and circled over the boat while the radio operator signaled them our friendly intentions. No shots were fired and we straightened away for the landing field.

We landed on the 11th of November after 11 hr. and 11 min. in the air. Bennett and two other planes were ahead of us. All arrived safely within an hour. The first mass delivery flight had proved to be a complete success. Lockheed planes and Wright engines had come through with flying colors.

As might have been expected in view of the secrecy with which our flight was prepared and conducted, there was no welcoming committee on hand. When all had arrived we proceeded to the RAF mess hall for a hot breakfast, which was most welcome. Not a word was said about the flight by Bennett, and no congratulatory phrases were wasted on us. England was at war and every man was expected to do his duty—even Americans. In this spirit we returned to Canada to carry on with the job. But just six weeks later, on Christmas Eve to be exact, when I was back in Newfoundland preparing to take off on my second ferry hop, a typed memo arrived from Bennett thanking us all for our contribution to the British War effort.

I might mention the fact that during that first ferry flight I smoked my most expensive cigarette. Smoking had been strictly forbidden while in the air, but during some of the anxious moments recounted above I sought solace and relaxation through a few hurried puffs. Somehow the organization learned of my fall from grace and I was officially informed that I had violated approved procedure, and was fined $100. Perhaps the most important lesson learned on that first ferry flight was: "Don't smoke while en route." I pass this advice along to all pilots aspiring to a place in the trans-Atlantic ferry service.

Detroit Airport

(Continued from page 52)

in the National Defense Program, needs an immediate field for manufacturing and testing, with neighboring property available for the construction of plane factories and the related services of the industry.

One subcommittee reported an estimated cost of upwards of $3,000,000 to acquire the property of the gas company bordering on the airport, remove the storage tank and lengthen runways to accommodate large transport planes. Even though these improvements were to be made, they would merely be of a temporary character and would provide no means for future expansion. And $3,000,000, reasoned the Airport Committee, would go a long way toward construction of a new and modern airport.

So Colonel Evans assigned a subcommittee to seek a new location and it went into action. This committee spent considerable time in the air inspecting likely sites. In all, eleven different locations were surveyed. The list was gradually narrowed for a variety of reasons, chief of them being that landowners, when they found out what was up, sought to skyrocket prices.

The committee learned that the state of Michigan held title to most of a tract of land roughly 6 sq. mi. in area bordering on the northern city line of Detroit.

State officials agreed to withhold the entire tract from public sale under the Scavenger Tax Act. Colonel Evans and his subcommittee selected a preferred square mile bounded by Eight and Nine Mile Rds. between Coolidge and Wyoming—an ideal location for the air traveling public of Detroit.

But no sooner had the news reached the public than an unholy cry of terror went up from surrounding communities. The desired tract itself is located entirely within the limits of the Village of Oak Park, tenanted largely by wage earners who welcomed the prospective increase in the village revenue which the new airport would bring. But the municipal neighbors of Oak Park, such as Ferndale, Pleasant Ridge and the highly restricted Huntington Woods and Sherwood Forest could not see it that way at all. These communities raised the familiar objections of noise, confusion and lowered property values, and undoubtedly had memories of a previous experience with the municipal activities of Detroit.

This was the community frame of mind Colonel Evans and his committee faced. The citizens held protest meetings, circulated petitions, got legal aid, and altogether raised such a hue and cry that the Board of Supervisors withdrew its approval of the new airport.

Then Colonel Evans really went into action. He didn't wait for the fighting mad citizens to come to him, he went to their meetings. They heckled him, they attempted to howl him down; they would scarcely permit him to talk. But he kept coming back for more. He employed courage, plain but persuasive common sense, plus a complete knowledge of the project he was presenting. Whether his endurance was greater than theirs, or whether they developed a secret admiration for his perseverance is beside the point. The point is that he continued to come back until the protesting voices gradually toned down sufficiently for the Colonel to tell his story uninterruptedly, in addition to getting in a few good licks in the name of patriotism and national defense. He and members of the committee, which includes such prominent figures as Wm. B. Stout, Gar Wood, president George Mason of Nash-Kelvinator, Col. J. G. Vincent of Packard, president Phil Huber of Ex-Cell-O, vice president Ernest Breech of General Motors, Durand Brown, G. F. Dittmer, A. L. Lott, R. J. Meurer, William Murray, John J. Ross, LeRoy C. Smith, Jay Gibbs and George N. Higgins sufficiently mollified the opposition to get the Supervisors again to reverse themselves and grant full and final approval for the project. Throughout its deliberation the committee has been actively aided by William M. Walker, Jr., Commissioner of Public Works.

The committee recommended to the Mayor that the new airport be confined strictly to the use of those planes equipped for instrument flying. This is an extra precaution for safety, according to Colonel Evans, which the present airport does not require. Thus the present Municipal Airport can be used for student training and flying, private ships and city air tours.

The committee has been advised that the Federal government and WPA officials had approved an expenditure of Detroit funds up to $3,500,000 for construction of runways and other developments of the project. Mayor Jeffries and the Common Council are expected to take immediate steps to expedite the matter and have been requested to approve condemnation proceedings to acquire the necessary property.

SAE Papers

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then, is the principal job that the air-scoop has to do.

It is recommended that in the design of a practical airscoop, the first lines laid in should be straight lines from the top of the carburetor flange and at right angles to it.

The elbow or turn in the scoop is usually the one feature which causes the maximum amount of difficulty . , most of the trouble is caused by the efforts which are put into providing a smooth turn. In such cases air entering the scoop simply cannot proceed through the scoop at high velocity without piling up along the outer radius.

The abrupt turn is definitely a desirable feature, provided that the cross-sectional area through the turn is not restricted by the use of a large radius for the outside of the turn.

In a smooth radius elbow the air is continually thrown against the outer radius by virtue of its centrifugal force, with the result that there is no opportunity for the flow to become equalized across the area of the passage.

In the case of most under-cowl types of scoop, the natural space limitations call for a design of passage which is rather low in the vertical dimension and rather broad in the horizontal dimension. A duct with a high aspect ratio is definitely recommended, and it should be continued in this form as close to the actual elbow as possible. In the case of the high aspect ratio elbow, the velocity along the inner and outer walls of the scoop differs by a materially smaller amount than is the case in the elbow of low aspect ratio.

In most scoop designs there is a definite limitation in overall height, and here again the high aspect ratio design is advantageous in that it permits a greater straight length of duct at the carburetor for a given area and given total height.

A third advantage of high aspect ratio is that the loads on the heater valve are reduced.

The function of the heater valve is to provide for the admission of hot air to the scoop in quantities ranging from zero to 100 percent of the total. In many designs of scoop where the heater valve is immediately above the carburetor entrance, it is a practical impossibility to obtain good temperature and pressure distribution at the carburetor, due to the extremely short distance allowed for the air to become mixed and its pressure equalized.

By putting the valve around the corner and ahead of the elbow, the turbulence produced in the elbow is used to assist in thorough mixing of the hot and cold air streams. Since the valve is at a maximum distance from the carburetor entrance, the pressure disturbance caused by variations in the valve position becomes a minimum.

In some designs of scoop that have been tested, it has been found that the major portion of the power loss experienced when going from full-cold to full-hot was due to constricted hot air passages in the scoop, and that the major changes in fuel-air ratio in going from full-cold to full-hot were due to pressure disturbances caused by the heater valve itself.

In the case of scoops which project above the cowl line, the shape of the scoop is usually pretty well established after the foregoing design considerations are followed. A certain amount of area is required to provide proper breathing capacity for the engine and the area of the mouth of the scoop should normally be kept within 75 to 100 percent of the area of the carburetor entrance.

In the case of under cowl types of scoops, the situation is somewhat more complicated due to the increased length of scoop and the necessity for turning several corners in going over the cylinders and coming out under the lip of the cowl. Here again it is felt that the minimum cross-sectional area of the horizontal passage of the scoop should be from 75 to 100 percent of the area of the carburetor entrance. In most types of under cowl scoops a fair amount of area is available at the mouth of the scoop to provide a good, smooth approach. Full advantage should be taken of all space at this point. The final vertical portion of the scoop leading to the carburetor entrance should be especially watched to prevent any rapidly diverging areas at this point.

Most of the material in this paper may be summarized in the following five rules:

RULE I—Provide the maximum length of straight section of scoop immediately ahead of the carburetor.

RULE II—Use a sharp right angle elbow—not a smooth turn.

RULE III—Maintain a high aspect ratio in the scoop passages and elbow, insofar as possible.

RULE IV—Keep the heater valve as far away from the carburetor as possible and locate it on the far side of the scoop elbow.

RULE V—Maintain at least 75 percent of the area of the carburetor entrance throughout the scoop and also at the heater valve. Avoid rapidly diverging sections, particularly just ahead of the carburetor entrance.

Icing Problems Attendant To The Operation Of Transport Aircraft

R. L. McBrien
United Air Lines Transport Corp

The ice formations adhering to the component parts of an airplane may be grouped into major classes: (I) those producing a loss of flight performance, and (II) those which serve as an annoyance to the operators or occupants without primarily affecting the flight characteristics inherent to the design of the aircraft or its engines.

Removal of ice forming on wings . . is not always assured by merely starting deicer operation as the icing region is entered and stopping their operation after emerging. Experience has shown that such a procedure often aggravates ice roughness along the wing without removing any appreciable amount. The procedure adopted has been to purposely avoid operating the deicers until an ice thickness of approximately $\frac{1}{8}$ in. is attained. They are then operated for a short period to sufficiently crack loose this thicker formation so that it is blown from the wing in sizeable sheets. The deicers are then turned off until the ice thickness again approximates $\frac{1}{8}$ in. Intermittent ice removal in this manner is continued.

Rubber inflation deicers bring up other points that bear mentioning. After their rubber ages or takes on a slight permanent set they lose some of the resilient qualities originally possessed. Eventually "ballooning" develops. Ballooning is a lifting of the deicer from the wing surface which makes the part appear to be partially inflated though system air pressure is not present in the tubes. Employment of vent holes in low pressure areas has only partially relieved the likelihood of ballooning.

The obstruction of the pilot's forward vision by ice accumulations on airplane windshields is probably the most frequently encountered annoyance formation. The most common method now in use for anti-icing windshields is the use of a heated air blast on the inside of the glass. The system is fairly effective in light and moderate icing conditions. In glaze and for rime forming at low temperatures, however, it is of no benefit.

Different fluids (alcohol, glycerine, ethylene glycol, etc.) have been sprayed against the outside of the glass. None have proven satisfactory in themselves.

In conclusion it can be fairly stated that much progress has been achieved during the past few years in the improvement of all aircraft anti-icing equipment. However, much still needs to be accomplished before air transport operations will be able to operate without regard to possible icing conditions.

Shear Lag Problems

(Continued from page 49)

Eqs (13) are the fundamental equations of the shear lag problem for the untapered beam and it is seen that finding the correction term $\bar{\sigma}$ is a problem of the same kind as the customary beam theory for combined axial and bending loads The manner in which Eqs (13) have been derived indicates that they are also valid for beams of variable height h and piecewise constant sheet thickness t For this kind of thickness variation it is only necessary to have $t\sigma_b$ and $t\bar{\sigma}$, continuous which in view of Eqs (6) and (9), means that $t\bar{\sigma}$ and $td\bar{\sigma}/dx$ have to be continuous along the sections where t changes

One may define an effective sheet width w_{eff}, which with Eq (6) becomes

$$\frac{w_{eff}}{w} = \frac{\int_0^w \sigma_x dy}{w(\sigma_x)_{elem}} = \frac{1}{3} + \frac{2}{3}\,\frac{(\sigma_x)_{middle}}{(\sigma_x)_{elem}} = \frac{1-(m-1)\dfrac{\bar{\sigma}}{\sigma_{bs}}}{1+(3-m)\dfrac{\bar{\sigma}}{\sigma_{bs}}}. \qquad (14)$$

Evaluating Eq (14) one finds that w_{eff} is the smallest at the root (most highly stressed) section and that one may write

$$\left(\frac{w_{eff}}{w}\right)_{root} = f\left(m, \sqrt{\frac{E}{G}}\,\frac{w}{L}\right) \qquad (15)$$

where f is a simple function of its two arguments m and $(E/G)^{\frac{1}{2}}(W/L)$,

$$L = \frac{M\,(l)}{\int_0^l p\,(x)\,dx} \qquad (16)$$

denoting the distance of the center of gravity of the load curve from the built in end of the beam (Fig 2)

No such simple statement is possible in the case of tapered beams *One of the purposes of this article is, however to point out that shear lag is to a considerable extent a function of beam taper, that is to say a function of the spanwise variation of width 2w, height h and sheet thickness t In most cases it will be found that taper reduces shear lag compared with what it would be for untapered beams* It is theoretically even possible to avoid shear lag entirely in the sense that every beam has fully efficient chord members for one kind of loading This is the case when the load distribution is such that the product of elementary bending stress σ_b, and the sheet thickness t, $t\sigma_b$, has a constant value all along the span

The equations for tapered beams w[illegible] for the beams of [illegible] are obtained [illegible] may be written in the form

$$\begin{aligned} &\frac{d}{dx}\left[\frac{1}{t}\,\frac{d}{dx}\left(mt\bar{\sigma}\right)\right] \\ &- w^2\,\frac{21m-15}{35m-21}\,\frac{d}{dx}\left[\frac{1}{t}\,\frac{d}{dx}\left(\frac{t\bar{\sigma}}{w^2}\right)\right] \\ &- 6\,\frac{G}{E}\,tc^2\bar{\sigma} = \frac{d}{dx}\left[\frac{1}{t}\,\frac{d}{dx}\left(t\sigma_{bs}\right)\right] \\ &(\bar{\sigma})_{x=0} = 0, \\ &\left[\frac{d}{dx}\,(mt\bar{\sigma}) - w^2\,\frac{21\,m-15}{35\,m-21}\,\frac{d}{dx}\left(\frac{t\bar{\sigma}}{w^2}\right) - \frac{d}{dx}\,(t\sigma_{bs})\right]_{x=l} = 0 \end{aligned} \qquad (17)$$

It should be noted that it is quite simple to integrate Eqs (17) explicitely without the use of infinite series, when m is constant and

$$t = k_1\,(x+x_0)^n, \quad w = k_2\,(x+x_0) \qquad (18)$$

with k_1, k_2, x_0 and n having arbitrary constant values

As an example of the application of the preceeding developments consider a beam of constant cross-section, carrying a uniformly distributed load p_0, so that $M = (\frac{1}{2})p_0x^2$ In this case

$$\sigma_{bs} = \frac{1}{2}\,p_0\,x^2\,\frac{h}{2I} \qquad (19)$$

From Eqs (13) follows

$$\bar{\sigma} = p_0\,l^2\,\frac{h}{2I}\,\frac{\lambda^2}{k^2} \left[\frac{\cosh k\,(1-x/l) + k\sinh kx/l}{\cosh k} - 1\right] \qquad (20)$$

so that the ratio of actual stress and greatest "elementary" stress is given by

$$\frac{\sigma_x}{(\sigma_{bs})_{root}} = \left(\frac{x}{l}\right)^2 - \left[m - 3\left(\frac{y}{w}\right)^2\right] \left[-1 + \frac{\cosh k\,(1-x/l) + k\sinh kx/l}{\cosh k}\right]\frac{2\lambda^2}{k^2}. \qquad (21)$$

If we take a beam for which

$$m = 2,\ \lambda^2 = \frac{49}{71},\ \frac{G}{E} = \frac{3}{8},\ \frac{w}{l} = \frac{1}{5},\ k = 6.25$$

we obtain the stress pattern which is plotted in Fig 3

It is believed that the present method, the chief results of which are the equations (6) and (17) represents about as convenient a solution of the shear lag problem for monocoque construction as it is possible to obtain

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Seaplane or Landplane

For Transoceanic Service

An inadvertent omission occurred when the conclusion to Mr M. E. Gluhareff's (Chief of Design Vought-Sikorsky Aircraft) article, appearing on page 38 in the March, 1941, issue of AVIATION, was not printed. Dealing with long range, transoceanic flying boats and landplanes, it was the author's belief that flying boats of 50-100 tons gross weight would compare more than favorably in performance with landplanes of similar size The conclusion to his article is as follows

Conclusions

Passenger and crew psychology of safety and security in case of forced landing in the ocean, is the factor, which is beyond the control of the airline operator and always will be a dominant one in a commercial enterprise.

A long range, transoceanic flying boat, equal with the landplane in gross weight, power plant and useful volume will carry appreciably better pay load at the same speed.

For equal pay load, the flying boat could be constructed lighter, therefore smaller, and less expensive and would travel faster than the equivalent landplane

With the exception of floating ice, takeoffs and landings of a properly designed flying boat are less hazardous than those of a landplane due to incomparably better facilities with regard to space and places available

Service and maintenance of the flying boat equipment in nonstop operation over the ocean should be less expensive per pound of payload carried

Finally, from the standpoint of National Defense, the mobility of self-contained flying boat units, which are independent of huge, well maintained fields, and the possibility to concentrate considerable numbers of ships almost any place on the coast, are advantages which cannot be easily overlooked

Ready-Made Airports

(Continued from page 33)

hours in locating proper fuel, some five gallon cans and a usually leaky rowboat. In spite of these difficulties it is a noticeable fact that seaplane fliers represent the most ardent group of enthusiasts in the flying fraternity.

The whole subject of seaplane bases has, in the past been notoriously neglected by most municipal, state, and federal airport construction programs. As a result, the Seaplane Flying Association and individuals have for several years besieged the Civil Aeronautics Administration with requests to alleviate the deplorable conditions. It was their contention that the federal government should participate in the construction, improvement, development and maintenance of a national system of small seaplane bases, which by definition of the Civil Aeronautics Act (Section 1 Paragraph 8 and 22) are included in the designation "Airports." It was their further opinion that the encouragement, by the federal government of such activities would do more, per dollar expended, than any other comparable program for the general development of private flying and would be of the greatest importance to commerce and the national defense.

It remained then for the foresight and vision of Major A. B. McMullen, Chief of the Airport Division of the C.A.A. to take the initial step. A seaplane unit was formed two years ago, with the writer assigned to the task of "covering the waterfronts" in all the states where such existed, which subsequently proved to be all 48 of them, with Alaska in the offing for good measure.

Together with the very able assistance of Major McMullen and his assistant W. G. Stewart, a comprehensive nation-wide program for the construction and installation of seaplane bases was drawn up. The first phase of this program was to conduct a comprehensive field, as well as office, survey and analysis of the entire subject of private and commercial seaplane flying in the United States with respect to the need for seaplane facilities. It was decided that the survey should cover among other points the following:

1. A study of the U. S. by means of large scale maps, supplemented by a field survey and the personal knowledge of experienced seaplane pilots, in order to determine and outline all suitable water flying areas.

2. An analysis of these areas in terms of their relation to adjacent water areas, their population and buying power, and their present landplane and seaplane activity.

3. A field survey of all areas where private seaplane flying is now being practiced or has been shown to be practical and desirable in order to compile a list of such seaplane bases as are now in existence, study their suitability and the reasons for their existence and determine the need for added facilities.

From the very beginning the survey revealed a tremendous amount of interest in water flying, the interest apparently having remained latent due mainly to a general lack of understanding of its basic requirements. The need of an educational program became apparent and information has and is now being disseminated by means of magazine articles, bulletins, radio broadcasts, addresses before civic organizations, service clubs and personal interviews with operators, airport managers, mayors, city officials and others. Complete working drawings and specifications were drawn up covering hangars, ramps, marine railways, dollies and other appurtenances for the efficient handling of all types of water flying craft and made available to anyone interested at no cost. Engineering and advisory service are also available to cities as well as individuals by application to the Airport Division of the C A A.

A Directory of "Seaplane Bases and Anchorages" has been issued, a sort of "Blue Book" enabling cross-country seaplane fliers to plan and chart their courses in advance.

Comprehensive written reports, together with aerial photographs of all water areas surveyed, are being filed for reference purposes and a great deal of valuable data has already been compiled which will enable the Seaplane Unit to render assistance and advice on best routes and available landing areas throughout the country.

The most important and beneficial step taken was for the immediate construction and installation of especially designed landing floats to which seaplanes could safely taxi for the discharge of passengers and refueling.

Sporadic attempts have been made over a period of years to interest various communities in the provision of these highly desirable facilities. Due to lack of interest and funds the results were disappointing. The Civil Aeronautics Administration was however fortunate in securing the whole-hearted and enthusiastic cooperation of the National Youth Administration for the actual construction and installation of small seaplane bases on a nation wide scale. Here was an exceedingly useful and instructive project for teaching our youth carpentry, machine work, the reading of blueprints etc., and the mere fact that it was connected with aviation gave it a zest and appeal which immediately captured the workers' enthusiasm.

So much has already appeared in print about this program that I will touch upon it but briefly. The success of the program has been quite gratifying and is due, I believe, to its simplicity and economic features. Suffice it to say that the National Youth Administration will construct and install landing floats, moorings, hangars etc., for any community which will provide the necessary materials. The landing floats measuring 10 by 22 feet are supported by steel drums, usually oil barrels, the cost averaging about $150 to $200 per unit. Several of these units

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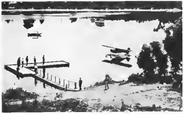

Flying a seaplane from peaceful rivers like this appeals to any pilot who loves the water. NYA ramp at the left.

Ready Made Airports

(Continued from page 142)

can be coupled together to form as large a float as may be desired. As all labor is furnished by the federal government, the project must be sponsored by a public agency such as a city, county, or state to place in any location approved by the C.A.A. The materials are furnished by cities, civic clubs, and in some cases by individuals. The floats are built under the direct supervision of expert carpenters and to standardized designs provided by the C.A.A.

As soon as established, these bases are listed in the "Weekly Notices to Airmen", in the "Directory of Seaplane Bases and Anchorages", and designated upon the Sectional Charts by a small red anchor. The program is now actively underway in 30 states with approximately 150 bases completed and 300 more under construction, surveyed and planned for. A chain of these bases together with refueling facilities is nearing completion, extending from Eastport, Me. to Key West, Fla. and along the Gulf Coast to Corpus Christi, Texas. A transcontinental seaplane route utilizing lakes, rivers and reservoirs is now under survey from the Atlantic coast to Seattle, via Chicago, St. Paul and the Dakotas, the completion of which this summer will permit seaplane owners to safely, comfortably and conveniently fly from coast to coast and border to border.

Whereas the purpose of the program is primarily to provide more adequate facilities for private and commercial seaplane owners, it is also of value in our national defense program in furnishing havens of refuge for Navy and Coast Guard seaplanes. One of these typical bases is located in what is usually thought of as a dry state half way across the country and is now being used as a refueling base for large bombing seaplanes being flown from a factory on the west coast to an eastern point for delivery to the British. As these large planes take on approximately 1000 gallons of gas each, the community has been well repaid for its relatively small initial investment.

A most important point to remember is the fact the airports regardless of size or cost can be quickly destroyed by bombs whereas water areas are entirely immune. Obviously such natural resources should not be overlooked by our military leaders. As a matter of fact there is not one single state in the union that does not have *from five upwards to several hundred suitable water areas* that are several times larger than the biggest airport in the world and ready for use right now. Based on official estimates, Wisconsin claims 3,000 lakes, Minnesota, 7,000, Maine 2,000, and so on. In the winter time the smooth frozen surfaces are ideal for ski-equipped planes, which incidently was the unforeseen manner in which German troops were landed in Norway, virtually unmolested.

W. B. Courtney, prominent aviation writer for *Collier's* magazine brought out in a recent article the interesting fact that Lake Mead, an artificial lake behind Boulder Dam, could accommodate all the naval planes of all the world's powers and barely shade its waters. Great Salt Lake is as big as Delaware, Lake-of-the-Woods is bigger than Rhode Island, Lake Michigan is as large as Maryland, Connecticut and New Jersey combined, and all are strategically located in juxtaposition to either Atlantic or Pacific coasts.

We already have flying boats, which stripped of non essentials, are capable of transporting 100 armed troops each from one extremity of the country to the other in a dawn to dusk flight. One hundred and fifty of them, costing no more than a single Navy cruiser, could quickly transfer a whole division to any state in the union or Alaska. Obviously, airport development should in no way be neglected but a water program should be correlated with it by utilizing our already existing natural resources.

Passing on to a lighter and more pleasurable vein and in conclusion I would like to explain that the writer is an Army trained "landlubber" who 18 years ago decided to try floats. I've been "web-footed" ever since. Until you try it you can't imagine the sport you've missed or the things that you can do and the places that you can go with water flying craft instead of always having to depend upon reaching an often times remote airport.

Just study a map of this country and you will discover that nearly all of our large cities, inland as well as coastal, are situated on or near suitable bodies of water. You can land "down town" in the very shadow of the buildings, at the front door of waterfront hotels, restaurants, country and yacht clubs and summer resorts, etc. If you are a fisherman or hunter and like out-of-the way and hard-to-reach places, there's nothing like a seaplane to get you there swiftly, comfortably and safely. Picture having breakfast in Boston or New York and dinner that night of freshly caught salmon in Labrador or Newfoundland as I've done it many times during the past ten years. So I say "Come on in—the water's fine"

Aviation in Transition

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low rate. Along with so many other uncertainties—such as new taxes—the financial community is not only trying to discount all possible effects of a war economy, but is also attempting to evaluate the post-war scene—a process that entails a longer survey than the stock market normally assumes.

With so much concern universally expressed as to the post-war status of the aircraft industry, it is particularly encouraging to note the cognizance given by aviation managements to future problems and measures taken to meet them.

In the forefront of future contingencies is the continued projection of research. In fact, the very nature of our tax laws is of sufficient import to encourage an accelerated rate of research. However, the aviation industry has seldom been known to subjugate research at the expense of obtaining an immediate profit.

Probably the most outstanding example of a pioneer in research is the Sperry Corporation. Accompanying its annual report are a number of pertinent observations which are worthy of comment here. While Sperry acknowledges its contribution to aviation, it takes pains to note that only 25 percent of the volume of its business is in aeronautics—hence it should not be labeled strictly as an aviation company.

The practical results of research are vividly illustrated by Sperry's experience. The company's development program is reported to have yielded many new products, which now constitute a substantial portion of the company's business. In other words, without research Sperry would have long fallen by the wayside—in fact, it would have had no reason for existing.

It is this constant search for new products, new techniques and their wider adaptation which gives the aircraft industry sufficient hope, come what may, it will be able to cope with its new problem in a post-war adjustment period.

The enactment of relief amendments to the excess profits tax law made some substantial differences in reported prof-

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5 Gun Turret

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tion of a second of time available, and then it is all over Either the target will have been hit by a few bullets, or he will have flashed out of range, untouched, all within a few seconds of time

The five-gun synchronously adjustable mount shown in figures 1 and 2 is designed to provide accurate division of leads between the five guns constituting the battery with instantaneous adjustment of each gun within a predetermined sector of operation

All five guns of this battery, which are light 30 caliber machine guns, are mounted upon a common cradle plate or pivot point. This plate or point is part of a mobile mounting, in this case the entire turret, which can be rotated through 360 degrees The gun mount within the turret may be raised or lowered and the guns themselves elevated or depressed as a unit, all of these operations being accomplished by hydraulic means

The individual guns are mounted on gun cradles or special adapters upon which they can recoil freely These cradles or adapters are fixed to the common base of the battery on a universal pivot point.

The center gun E is fixed to the cradle plate or pivot point, and it is with this gun or rather, with sights aligned parallel [illegible] gun [illegible] the sighting and aiming is done. Guns A, B, C and D, however, are flexible being actually free guns within the limitations imposed upon them by the cable control system designed for use with this battery.

By synchronization we mean the mechanical coupling of the diagonally opposed guns A-C and B-D (See Fig 2) One lever controls the movements of guns A-C and the other lever those of guns B-D. These two units are therefore independent of each other The gunner controls both levers and thereby the complete movements of the four outer guns, with respect to center gun E.

The control system has been so designed that at a range of 1000 yards which is actually beyond the range at which combat usually takes place, each of the four outer guns has a maximum radial movement of 50 yards (See Figure 3) When operating the battery and the controls are left at normal, all five guns will fire at one point When under adjustment, however, each of the four outer guns A, B, C and D can be controlled through, and extended within a 90 deg sector of a circle, the size of which sector or circle being determined by the range at which the target is located, and the degree of control adjustment imposed

It is evident, that under many conditions of aerial gunnery, this adjustable battery will accomplish what hitherto has been impossible with a fixed group of guns firing at one point According to the movements of the target, the [illegible] instantly and at will deploy [illegible] outer guns of the battery in the [illegible] favorable position for assuring some hits These positions will vary accordingly as the target is coming at or going away from the defending plane, or flying at some particular angle An immense range of positions can be taken up by the four guns under adjustment The absolute ideal would be to have each gun individually controllable by the one gunner, so that every possible sort of curve using the five guns as a basis could be placed within the circle which comprises the maximum spread of the guns At present when gun A is moved anywhere within its sector of operation, gun C follows the same movement inversely in its own sector

The particular point of interest in this system of fire-pattern control is that under any condition of adjustment imposed by the gunner, the division of leads between the guns would be accurately spaced from center We see that the guns composing the battery can be deployed absolutely horizontally or vertically, so that five lines of fire can be swept across or along a target, depending upon conditions And furthermore, the outer guns can be placed at will in any part of the sector in which they can operate, with the exception that diagonally opposed guns follow each other inversely.

Figure 4 shows the original conception of this multiple mount, which allows only for spreading the four outer guns at a 45 deg angle to the fixed center gun E This was a controlled dispersion system When we add two-directional adjustment to the battery, it can no longer be called a dispersion device, as dispersion does not enter into the picture at all. In fact, dispersion as such is undesirable, as we have a haphazard spacing of the bullets of each gun With the system just described the pattern of fire from each gun can be accurately controlled from a straight concentration of fire of all five guns, to a variable pattern which is restricted only by the design of the controls

The control system must be designed to fulfill certain conditions Paramount among these are

1 Control by one gunner
2 Instantaneous control
3 Smooth control throughout the field of adjustment

A cable control system such as is applied to the present battery appears to most closely comply with these conditions, and at the same time offer a simple mechanical apparatus An alternative would be a system of links and levers, which might be cumbersome and slower in acting

To obtain the maximum radial movement of 50 yards at a range of 1000

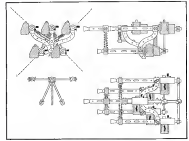

Fig 5. The 5-gun aircraft mount based on radial controlled dispersion system. Adjustment was by means of a single control lever, with mount fully flexible.

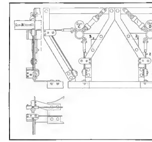

Fig. 6 Detail of cable control framework for lower guns "C" and "D" 1, Return or centering spring, 2 control cables; 3 guides for keeping guns aligned 4 front end of gun cradle to which control cables are attached The gun itself is free to recoil on the cradle or adapter

yards, each of the four outer guns has a radial extension of 2 deg 52 min at the gun muzzle The actual movement at the muzzle is therefore less than an inch The angle through which the two control cables of each gun moves is of course made greater, so that the braking effect of the return or centering spring is not too much at the maximum extension of the guns Vibration of the guns while firing and the jumping action which builds up and causes the muzzle to have a tendency to elevate might prove to have too much counter effect to the braking action of the return spring, and this spring may be replaced with a third cable, which would definitely provide smooth control of the guns throughout their operating range, but would not provide for the automatic return of the guns to normal or concentrated firing position The gunner would then always have to do this manually, which may not be a serious objection

The mounting arrangement of the five guns with respect to each other may be in any manner compatible with the small space available in a turret The mount shown in the figures is mechanically well balanced, provides head room for the gunner and the control system, and allows sufficient room for quick replacement of ammunition magazines, or cartridge belt feeds For nose and tail turret positions other arrangements of the guns will prove desirable

The effects of a variable controllable fire pattern out of a multi-gun aircraft mount can only be shown in actual combat Besides spreading a number of lines of fire accurately, it will undoubtedly disconcert attacking planes, the pilots of whom will soon become aware of the fact that they find themselves in a constantly changing cone or zone of fire, instead of in one fixed zone, out of which they can easily maneuver Coupled with increased scoring effectiveness of the multi-gun turret, the psychological implications involved are also of importance in air warfare.

It is necessary to note that the variable fire pattern control theory does not require five guns as a basis; four or even three guns may be mounted for adjustment under the same system

About the Author

Mr Bruchiss's connection with aviation began in 1929 when he was a radio engineer with Universal Air Lines, before it was taken over by United He has spent the past decade in Europe as correspondent and aviation writer In 1936 he became interested in aircraft and anti-aircraft armament, and currently he is engaged as armament engineer for one of the large eastern aircraft manufacturers

Aviation in Transition

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its for most of the aircraft builders This was demonstrated in the case of the Glenn L Martin Company This company reported preliminary earnings for 1940 of $3 92 a share This was prior to the enactment of the tax amendments The revised report now shows that the company was able to retain additional earnings of $1,118,000 to bolster last year's results to $4 94 a share Revised earnings for the major companies are shown in Table I

While the aircraft group was hard hit by income taxes last year, they nevertheless showed earning progress over 1939 For example, almost 60 percent of United Aircraft's net income went to the Treasury for normal and excess profits taxes. Sperry paid more than 50 percent of its earnings for taxes

Yet despite these heavy imposts both companies showed worthwhile profit increases over the previous year.

Among the most important measures of managerial efficiency is the profit margins reported on the year's business In view of the severe nature of taxes Table I presents 1940 profit margins for the major aircraft builders before and after taxes An examination of the final results reveals some very interesting facts pertaining to the relative position of these companies. The best showing, before taxes, was made by Martin, North American and United Aircraft. Earnings after taxes, however, were best retained by North American Douglas and Martin In these and other cases, the relative high profit margins may be attributed to the preponderance of deliveries on foreign contracts While an important amount of foreign business is yet to be delivered—these high profit margin sales are rapidly being exhausted The bulk of billings for this year promise to be of a low profit nature as they are for the account of the government

In reading summarized results for one year, it is sometimes possible to make some erroneous deductions as to trends For example, North American Aviation, Inc reported net earnings of $2 06 per share for 1940—the same as for 1939 On the surface, this can be interpreted as indicating lack of progress on the part of the company However upon closer analysis we find the company, after showing 97 cents a share for the first nine months of 1940, earned $1 09 a share in the final quarter, This would indicate earnings running at the annual rate of at least $4 36 per share We note further that in December 1940, the company delivered approximately twice the number of planes shipped during the best month of 1939 Should any doubt remain as to North American's sharply mounting rate of plane deliveries we refer to President Kindelberger's statement commenting on December production schedules as "even this record will soon fade into insignificance"

Acrobatics Are Easy

(Continued from page 35)

the right wing is nearer the horizon the stick should be moved to the right If the ship is not pointing directly along the road as it begins to recover from the dive, you have applied rudder one way or the other and should correct this with slight opposite rudder If the wing showed a tendency to wobble on the way down, you pulled the stick back too quickly and stalled at the peak of the loop (Incidentally, your airspeed at the top should be 60 m p h or more, though you were probably too excited to watch the indicator) It is difficult to realize that a ship can be stalled in a vertical dive, but if its angle of attack is increased beyond the burble point, it will stall regardless of its position.

In your effort to avoid pulling the stick back too quickly, don't make the mistake of not bringing it back quickly enough. If you are too slow, you will use up all of your speed in the climb and may stall with your nose straight up This is extremely likely to produce a whip stall, about which you have been cautioned before If this unpleasant contingency occurs, and you feel that the speed is practically gone, apply full rudder to either side and as the nose comes around, ease the stick slightly ahead so as to regain flying speed, then level out as from a normal dive The procedure just described is useful only as a showy stunt, or in avoiding the whip stall It is known as the hammerhead stall

There is not much else you can do wrong in a normal loop, so we will proceed next to the loop with quarter-roll recovery

Loop With Quarter Roll Recovery

This maneuver is illustrated in Fig. 2 Its purpose is to afford initial practice in aileron rolls, but in addition to this, it is a lot of fun and after you have tried it a few times you will probably want to be doing it at every opportunity It is almost as simple as the normal loop, the only difference is that a trifle more altitude is lost due to the fact that the ship is held in a vertical dive for a few seconds

The maneuver is performed as follows: select a straight road or railroad lying directly up and down wind, then head the ship into the wind and along the road just as in the case of a normal loop Execute three-quarters of the loop in the usual manner Just before the nose is pointed vertically downward, move the stick ahead to neutral so as to maintain a vertical dive As soon as the stick reaches the neutral position, apply full aileron to either side, and enough rudder on the same side to offset aileron yaw As the wings become parallel to the road stop the rotation by bringing the stick to the center and releasing the rudder pressure, and immediately ease the stick back to recover from the dive The stick should be brought back smoothly since considerable speed will have been attained in the dive and an abrupt backward movement will impose severe stresses on the airplane with consequent discomfort to the pilot and to the passenger, if any

It will be found that the ship rolls quickly and easily Since it is traveling straight down, it has ample speed for the ailerons to be effective and since gravity is acting along the longitudinal axis there is no resistance to rolling and no tendency to sideslip as is the case when the longitudinal axis is horizontal. As in all other maneuvers, which can be done in either right or left, a quarter roll in one direction should be followed by one in the opposite direction, looping again first, of course

If you have learned how to do a good loop, you can't get into much trouble with the quarter-roll loop The commonest fault is rolling too late, or after the ship has passed the position of the vertical dive The next most common fault is rolling too early The third and last that is likely to be displayed is rolling through more or less than 90 deg Some instructors insist that the maneuver be done over two roads which intersect at 90 deg This is not considered necessary and further more it is often difficult to find 90-deg intersections, and even more difficult to find one in which one of the intersecting roads is in line with the wind direction. Since if the loop is done directly above a road and in line with it, the ship will be pointing at the road in a vertical dive, there is no difficulty whatever in determining whether or not the wings are parallel to the road at the completion of the roll The maneuver can be performed regardless of wind direction, but if the wind is blowing across the road with appreciable velocity, the ship will be blown to the downwind side and will not be in line with the road as it recovers from the loop Thus maneuver, like the normal loop, can be performed either up or downwind, but if started into the wind, will produce a much more perfect loop as viewed from the ground The value of the quarter roll loop will be appreciated when you have begun practice in the next maneuver

The Cuban Eight

The Cuban eight, so-called, we believe, because it first came into general use with the Cuban air force, is illustrated in Fig 3 It will be observed that the flight path of the ship describes a figure eight lying on its side. The maneuver is extremely valuable since it bridges the gap between the quarter-roll loop and the Immelman, serves as an introduction to the slow roll and slow half-roll, and gives the student just a taste of true inverted flight, in which he is hanging on his belt For this last reason it is highly important that the belt be pulled very tight as described in the first article in this series

To execute the Cuban eight, proceed as follows find our same old road with the wind blowing along it, or if the wind has shifted, pick another road. In this case the road should be straight for at least ½ mile, and more if possible Start the loop as usual, but this time as the peak is passed and the nose drops below the horizon, do not close the throttle entirely but leave it about one-quarter open When the nose drops about as far below the horizon (inverted) as it was (right-side-up) just before the loop was begun, push the stick far enough ahead to hold the ship in an inverted dive. (It is probable that the stick will have to be ahead of neutral to accomplish this and to prevent diving more steeply) As you do this you will have a most uncomfortable sensation, assuming that it is your first experience with inverted flight The blood will rush to your head, making it feel several sizes larger You will find, strangely enough, that though you thought you had tightened the belt as far as it would go, you were mistaken and there is still some slack in it, which is now being taken up You will have the uneasy realization that there is nothing between you and mother earth except a few thousand feet of thin air and that belt But don't worry, it will hold you and you will find after a few trials that you rather enjoy the sensation For the first time in your flying career, you're advised to hold your feet quite firmly on the rudder pedals, otherwise they will slip off and wave around in the air and you will have a heck of a time getting them back where they belong In fact the instructor will probably have to roll the ship right-side up before you succeed in getting those size 12's back on the pedals. Well, we have left you in that inverted dive long enough

The ship should be held on its back until the speed has reached about 90 m p h Remember that on top of the loop your airspeed was down to about 60 m.p.h., and if you were a little careless, it may have been even less To roll at this speed is difficult because the ailerons have lost much of their effectiveness It will take only a few sec-

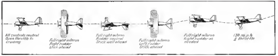

Fig 4 The slow roll.

onds of inverted flight (though the first time it seems much longer) to pick up the necessary speed, for the rate of increase is very rapid when the ship is inverted. When 90 m.p.h. has been attained, you are ready to roll right side up. Let's assume that the first roll is to be made to the right. Keeping the stick in the same fore and aft position, move it as far to the right as it will go, at the same time applying enough right rudder to maintain direction. As the ship rolls through the position of a vertical bank, additional right rudder will be needed to keep the nose from dropping; then as the wings approach the level position, the rudder is gradually eased off and the stick brought back to the center but still kept somewhat ahead of neutral so as to maintain the dive.

At this point, the engine, which has probably stopped, will start running again and the airspeed should be about 120 m.p.h. Maintain the dive until the proper speed for the loop has been acquired and execute the maneuver again, this time rolling to the left. As many more eights may be performed as desired but it will be noted that with the average training plane some altitude is lost in each loop. Don't let your enthusiasm run away with you to the extent that you'll continue practice below a safe altitude. This maneuver should be practiced long and conscientiously until it can be performed perfectly, for it will make things much simpler in other maneuvers further on.

There are several errors which you are likely to make at first. One of these is attempting to roll too soon due to your natural reluctance to pushing the stick ahead when you are upside-down. If you give way to this tendency you will make a very sloppy roll and will probably come out pointing in some direction other than straight down the road. In fact you may have difficulty in rolling at all, instead of making a nice clean job you will simply wallow into a right-side up position. Another error is waiting too long to start the roll. This will bring you out in practically a vertical dive, from which you will have trouble making the second half of the loop. Improper use of the rudder will prevent your maintaining direction; using the ailerons too delicately or coming back with the stick when the wings are vertical will have the same effect, but once you have learned the proper coordination and timing I'll guarantee that you will like the Cuban eight.

The Slow Roll

This maneuver, illustrated in Fig. 4, is considered by many to be extremely difficult. Actually it is not difficult at all. If you become proficient in the Cuban eight the slow roll will give you little trouble in any airplane of reasonable power and controllability. When performed properly, with the nose held dead on the horizon, it is extremely graceful and spectacular. In it, probably more than in any other maneuver, smoothness, delicacy in control operation, and relaxation of the pilot should be emphasized. If there is a convenient brace or solid structural member within reach, it is recommended that you get a firm grip on it before the roll is begun, particularly if the ship is one which requires extreme forward movement of the stick to hold the nose up while inverted. This in no way corresponds to "pulling leather," or catching hold of the saddle while riding a horse, nor is it an indication of nervousness. It simply serves to keep you from falling to one side of the cockpit when the wings are vertical, and to enable you to pull yourself ahead if this is necessary to get the stick far enough forward.

The slow roll is begun by setting the stabilizer to a slightly noseheavy position and diving the ship in a rather shallow dive until a speed of about 130 m.p.h. has been attained. The throttle is eased back during the dive so as to keep the *r.p.m.* within the proper limits. This means that eventually the throttle will be only about one-quarter open. When the airspeed indicator shows the proper reading, let go the throttle and, if you think it desirable, get hold of the brace previously mentioned. Ease the stick back *gently* until the nose rises just above the horizon. Then move the stick smoothly all the way to one side. For the sake of simplicity of explanation, let's make it the right side. At the same time apply enough right rudder to offset the aileron yaw and maintain a straight course. The course should be determined by some object on the horizon, preferably a cloud, which will remain visible throughout the maneuver. As the bank approaches 45 deg. it will be necessary to move the stick somewhat ahead of neutral, so as to hold the ship on the course, at the same time releasing the pressure on the right rudder pedal and applying slight pressure on the left pedal. Be careful not to push the stick too far ahead at this point, for if you do you will push the nose off the mark. As the ship rolls into the position of the vertical bank, more and more left rudder will be needed to hold the nose up. Meanwhile, and throughout the maneuver, full aileron is maintained. As the ship rolls past the 90 deg. (or vertical bank) position the stick must be moved further ahead, replacing the rudder action in holding the nose up until when fully inverted the rudder is in neutral and the stick well ahead—in some cases all the way ahead. Once more, however, you are cautioned about too much forward stick while in the 90-deg. position, either while approaching the inverted position or during the second half of the roll.

When the ship is on its back the nose should be slightly above the horizon. As the roll continues, right rudder should be eased on and the forward pressure on the stick gradually relieved. When the wings are again vertical, approximately full right rudder is being applied, full right aileron, stick ahead of neutral. As the wings approach level the right rudder is eased off, likewise the side and forward positions of the stick so that all controls are in neutral just as the ship resumes normal flight.

The throttle has remained in its closed position throughout the maneuver. The engine stopped functioning while inverted but will start running again as level flight is resumed. However, since the throttle was partly closed it will not start with a bang but will take hold smoothly and easily. Some pilots give full throttle as the roll is begun. In this case, the engine stops just the same while it is inverted and when the wings become level starts at full power and spoils the smoothness of maneuver, unless, of course, the throttle is closed at the completion of the roll.

The errors you are likely to make

are first, improper use of the elevators, particularly in the 90-deg and 270-deg position second, failure to apply and hold full aileron, third, getting mixed up on the rudder and applying right rudder when you should apply left, or vice versa.

As a final caution, you are warned once more to see that your belt is tight and that it has not become accidentally unfastened before you start your practice in slow rolls

Inverted Coordination Exercise

The practice of inverted coordination is an exercise which is not commonly introduced in texts on flying The writer considers it extremely valuable Once it is begun, you should practice it for five minutes or so on every flight until you are thoroughly proficient There is nothing else which will go so far in making the embryo acrobatic pilot thoroughly at ease, regardless of the attitude of the airplane In introducing this exercise there is no intention of developing an expert in inverted flight Its purpose, as explained above, is purely to make the student feel at home and relax while hanging on the belt, and to enable him to become familiar with the position of the nose with respect to the horizon at various speeds while up-side-down You will find the slow half roll, the half snap roll, and the Immelman much easier after a little practice in inverted flight Also, a good pilot should be completely at ease in any attitude that the airplane may assume Unless there is deliberate practice in the inverted position, it will require many hours for this relaxation to be brought about

Considerable altitude—6,000 ft. or more—should be acquired before the inverted flight is begun, because in the standard training airplane the engine will not run when the airplane is inverted Hence, all practice in this type of maneuver must be done in an inverted glide Most airplanes lose altitude very rapidly while gliding up side-down, and unless the glide is started fairly high, very little practice can be obtained before it is necessary to return to normal flight

You have already had practice in the slow roll The first half of the slow roll is probably the easiest way to get the ship inverted The roll should be made with the nose somewhat higher than is necessary for a complete slow roll, also it is desirable to set the stabilizer to the full nose-heavy position to lessen the forward movement of the stick As soon as the ship is on its back, the throttle should be closed and the ailerons neutralized, the stick being kept well ahead and the rudder in neutral The nose should be appreciably above the horizon Just how much will vary with the individual pilot To the average pilot, the distance between the cowling or the rocker box of the number one cylinder appears to be about a foot The best check on the position of the nose is the airspeed indicator, if one is provided This should read about 90 m p h and never more than 100 m p h After you have gotten accustomed to hanging in the inverted position for a few seconds you will find time to watch the airspeed and check the position of the nose when the indicator gives the proper reading

Hold the ship in a straight glide until you have come down to about 3,000 ft, then complete the roll in the same manner as the second half of an ordinary slow roll Open the throttle and climb back to the original altitude

On the second or third inverted glide you may begin to practice inverted turns These may be confusing at first, because the rudder and ailerons are apparently crossed that is, if the stick is moved to the right left rudder is used and vice versa To clarify this seemingly unusual procedure, let's assume that we are going to make a right turn as viewed from the pilot's seat. This will, of course, be a *left* turn as viewed from the ground To start the turn, the wing to the right of the pilot must be dropped or brought closer to the ground This means that the stick must be pressed toward the pilot's left At the same time, pressure must be exerted on the rudder pedal on the pilot's right. Thus we have right rudder and left aileron If the reason for this is still not clear to you you had better get hold of a model or make one out of paper hold it in the inverted position, then bank it and make it turn, setting the controls to produce the desired movement You will then see immediately why the controls must be crossed

As the bank is established you will find that you will have to exert a little more forward pressure on the stick to make a good turn This corresponds to the *backward* pressure required to make a good turn in normal flight

During initial practice of inverted turns, the bank should be about 15 deg Make your first turns through 360 deg After proficiency has been gained you should also practice S turns similar to those normally included in your preliminary training Five minutes of such practice in every lesson period will be found of tremendous value

As to the errors which you are likely to make the commonest is allowing the nose to drop and the speed to increase unduly You cannot appreciate how easily and quickly this can occur until you have seen it happen The writer well remembers his own early practice in inverted flight and hearing his instructor's calm drawl through the speaking tube "Get your nose up, kid, we're going like the hammers of hell" A glance at the airspeed showed that in seemingly a few seconds it had jumped from 90 m p h to 140 m p h

It should be pointed out however, that the nose can be raised too high and what may happen then is an inverted spin

The Inverted Spin

After your first or second inverted glide you should, by all means, deliberately put the ship into an inverted spin so that if it happens accidentally in some of the later maneuvers, you will know what to do to recover

To execute an inverted spin, roll to the inverted position as explained above Push the stick fully ahead and hold it there until the airspeed has dropped as low as it will go, which is probably between 60 and 70 m p h in the ship you are likely to be using Holding the stick fully ahead, apply full rudder to either side It is only fair to warn you that the ensuing events are likely to be rather unpleasant when first experienced In the normal spin, the pressure caused by the centrifugal force is down pushing you more firmly into your seat. In the inverted spin the reverse is true. The force tends to throw you out of the cockpit, head downward. If you have drunk any liquid shortly before, you are likely to feel as though it were trying to run out of your mouth

Fortunately, recovery from an inverted spin is extremely swift and easy. Simply neutralize the rudder and pull the stick quickly as far back as it will go The spin will stop immediately and the ship will come out in a normal dive

And now having gotten you safely out of that predicament, we will leave you until next month

Window Shopping

Hancock Superfinished "500 Brinell" Bronze Valves—An 8-page bulletin describing application of new Superfinish operation to manufacture of bronze valves. Hancock Valve Division Manning Maxwell & Moore, Inc, Bridgeport Conn

Micro Switch Catalog—Complete engineering data on precision snap-action switches—dimensions prices operating characteristics and information as to use Micro Switch Corp Freeport Ill

Meet Joe Green Grinder Hand"—Of immediate concern to the industry this brochure "For Grinder Men Only" deals with the spoilage of tools by new factory hands Helpful instructions on how to handle grinding tools etc Korbel Diamond Tool Co 9350 Grinnell Ave, Detroit Mich.

American Swiss Files—Informative catalog on American made Swiss pattern files More than 3,000 different shapes cuts and sizes listed for tool, die and pattern makers American Swiss File & Tool Co 410-416 Trumbull St Elizabeth N J


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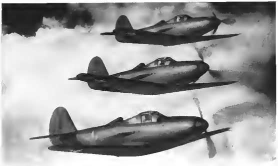
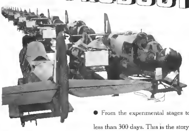


PRODUCTION!



Planning

(Continued from page 82)

A study which was made in 1937 for the procurement planning section of the Air Corps on how in the event of an emergency, a rapid rate of expansion could be accomplished, led Hamilton Standard to recommend, among other things, the installation of a new system of manufacturing and inspection control as the system then in effect would not accomplish the purpose since it lacked the flexibility for utilizing available material and machine hours obtainable through multiple shifts The rapid rate of increase at the beginning of such an expansion period, the first of the four basic differences just mentioned, made this new system almost mandatory under such conditions The change requested in the new system was the replacement of Army source-inspected material, Navy source-inspected material, and commercial inspected material, together with their three sets of records and controls, by one group of inspected material which would be acceptable for any use (Forms were cut from 63 to 26) The simplification in paper work affected by this new system almost eliminated the necessity of any increase in personnel to handle adequately the increase in the ordering department as the principal factor in increasing this load is the increase in the number of designs and parts It is obvious that this change greatly accelerated the rate of ordering materials With the active and enthusiastic cooperation of the Army and Navy the change to the system was effected in 1939 (Fig 2—chart showing simplification effected by new control system) This change made possible —

1 Quicker Initial deliveries of government contracts
2 Flexibility of schedules
3 Availability of materials for Army and Navy requirements for all types in stock
4 Simplification in procurement procedure
5 Closer control of inspection standards
6 Increased efficiency in the manufacture of propellers

The second phase of planning resulting from the rapid rate of increase was that of eliminating, wherever possible, those matters and decisions which depended upon opinion For example, the acceptance of minor parts which are highly stressed, and made from alloy steel, is based on the magnaflux inspection This inspection method can easily allow personal opinion as to the seriousness, location, and size of the indications to destroy all uniformity or acceptance or rejection. The engineering department sensing the acuteness of this particular situation, rationalized this problem and brought it down to dimensional measure and plainly determined the positions and sizes of acceptances and rejections

Prior to this time there were rejections of from 33 to 66 percent, which made it impossible after having expended man and machine hours, still to maintain schedules Today, under these new specifications, the rejections have been reduced to approximately 2 to 5 percent without impairment of quality.

Referring again to the procurement planning study made in 1937, it is stated that the then present personnel would provide the nucleus of the supervisory force in the event of an expansion. The curve shows there is a comparatively short period for the peak As a matter of fact, production has never yet reached that peak (Fig 3—chart showing successive scheduled steps of accelerated production) This chart clearly shows that no sooner is an objective reached than it is swallowed up in a new endeavor In fact, three times the new schedule took effect before the previous one could be completed Therefore, the peak is expected to be of short duration so that whatever additional men or equipment are to be used will be used only a comparatively short time

A further result of the apparently short period of the peak is the use, in certain instances, of second hand equipment It is sometimes possible to obtain, at comparatively low cost and quick delivery, second hand equipment which will be adequate for short term use Such equipment, of course, is not used for precision work or, in the case of office equipment, for permanent installation

The third difference in the characteristics of the expansion curves was that the volume in the accelerated production reached a peak which was extremely high compared to the normal base This difference makes it almost mandatory that new methods be found Wherever possible, the method used whether it was manufacturing, clerical, or supervisory, was simplified The simplification of manufacturing methods was accomplished, wherever possible, by the adoption of single purpose, high production, accurate machine tools By this means they reduced the requirement for floor space, for skilled labor, and for the number of machine tools The increase in volume allowed them to arrange their equipment in functional lines Further development of the same idea led to installation of conveyor lines which again reduced the requirement for floor space, reduced the amount of materials handling labor, and simplified the job of supervision This policy of simplification is not limited to manufacturing operations It is extended to all the overhead departments A request for an addition to overhead personnel is frequently resolved into a simplification of the function for which additional help was requested For example this expansion has obviously increased the load in the personnel tool engineering, and ordering departments Instead of expanding these departments in the same ratio as the load, advantage was taken of the increase in volume to simplify the systems and to procure mechanized equipment. The result of this philosophy is shown on Fig 4 (Chart

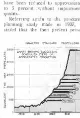


Fig. 3

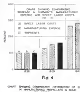


Fig 4

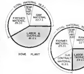


Fig 5

showing comparative increase in shipments, manufacturing expense and direct labor.) This is an index chart with the year 1938 set at 100 for shipments, manufacturing expense and direct labor. It shows that in 1940 the shipments were almost quadrupled over 1938 while the manufacturing expense was less than tripled and the direct labor was increased even less than manufacturing expense.

The fourth difference, although not shown on the chart, is perhaps one of the most far reaching influences, namely the rapid rate of decrease at the end of the expansion period. This condition was recognized early in the planning and, through various discussions, the following policy was adopted.

The expansion in the present plant should proceed only to a point where no more labor was available within comfortable commuting distance. The company would then let the additional expansion be located where there was an available surplus of both plants and labor. This was done in order that there should be no disintegrating effects of mushroom growth in the community in which the plant is permanently located. It was further decided that for some of the major parts which, by the way, are manufactured to a close tolerance and can be produced accurately and economically only on semi-special equipment, they would be produced by satisfactory subcontractors.

These steps made it possible to spread part of the load over many widely scattered communities, all of which were eager to participate in this work. In none of these communities is this additional load expected to be sufficiently large to raise any unusual problems after the expansion period is over.

Following out this plan, what was called an assembly plant was established. It is here that a large portion of the present schedules will be executed. In this plant will be assembled propellers whose parts, with the exception of blades, will have been made principally by subcontractors. This plant is located in a community that otherwise would have hardly felt any of the effect or reflections of increased payrolls directly connected with the present defense program. This plant, a textile plant idle for years, was reconditioned and made suitable. The rent will help its owners to provide carrying charges. It will again give to those people who perhaps became unemployed at the time this plant shut down an opportunity to be gainfully occupied.

Following this plan of renting a plant for the manufacture of blades and assembly only, the percentage of all material, including subcontracted parts, was increased from approximately 58 percent in Hamilton Standard's own plant to 75 percent in the rented plant. (Fig. 5—distribution of effort in manufacturing propellers—East Hartford and rented plant.)

From the foregoing planning doctrine a definite planning method was worked out—in the following manner. When an increase in output is required it is first necessary that a specific schedule be issued showing by actual design numbers how many assemblies are required and when they are required. This assembly schedule is then broken down into parts and a decision made as to what subcontracting policy will be followed. The parts to be manufactured are then broken down into a series of operations and the existing equipment machine loaded on a three shift, six-day a week basis. Equipment which had previously been acquired for normal operation, that is to say two shifts, five days a week, can, of course, produce approximately two thirds more by manning it three shifts, six days a week. At this point a rule of thumb can be formulated that all equipment must have a production rate of a definite quantity per hour, or to put the same thing another way, there is a limit set on the longest operation permissible. This can be determined from the original assembly schedule after making a suitable adjustment for spares and scrap allowance.

The results of the machine loading study will fall into three general classifications. The first will consist of operations with a large overload—that is to say—more than 100 percent. This overload necessitates finding a new method for performing the operation because unless this is done at least two machines exactly like equipment on the floor must be ordered. Overloads ranging from 25 percent to 100 percent are frequently solved by duplicating equipment, although an improvement in tooling can sometimes accomplish the desired result. Overloads of less than 25 percent seldom are met by procuring additional equipment since it is usually possible to find some means of improving operations, tooling or methods by that amount.

As the equipment is ordered, a machinery schedule based on the manufacturer's quoted delivery date is drawn up. This schedule is checked against the objective (the original manufacturing schedule) to make certain that the equipment will be received in time. Of course this does not always happen. When the machinery schedule shows that a particular piece of equipment is going to be late, efforts are made to improve the machine delivery. Failing this, arrangements are made to have a substitute means of performing this operation until equipment is delivered.

North American

(Continued from page 37)

geographical position of the plant reduces its vulnerability to attack. This is further aided by the night blackout of its windowless exterior, and the same feature promotes daytime camouflage. Establishment of the plant in the Dallas area reduces vulnerability of the aircraft industry as a whole, due to dispersion, and also helps assure uninterrupted materials shipments and availability of adequate labor supply.

Consisting of seven units, the 1,022,400 sq ft. Dallas factory has a main building 900x950 ft, in size, a hangar building of 45,000 sq ft, drop hammer building of 15,000 sq ft; foundry of 25,000 sq ft, a 10,000 sq ft paint shop, a power house of 10,000 sq ft and 15,000 sq ft. office building. All units except for a small portion of the main building are of single story construction. Roofs consist of a steel deck with 2½ in. of asphalt-dip cane fiber insulation covered by tar and gravel for weather proofing. Floors are of 5-in. reinforced concrete laid over a 3-in. sand cushion. Exterior walls are entirely windowless, of volcanic ash tile block construction, on a 5 ft base wall of concrete running completely around the building. The four sections of the main building include engineering, warehouse, manufacturing, and final assembly. The final assembly bay is 150 ft wide and 950 ft long, with 150 ft span steel roof trusses having a 25 ft floor to ceiling clearance for 650 ft, and 16 ft clearance for the remaining 300 ft. The engineering department is accommodated on the floor above this low bay portion of final assembly. Uniform clearance in the 576x950 ft manufacturing section is also 16 ft. A centrally located paint shop provides 15 individual spray booth units, while the entire shop is protected by fireproof walls and doors and by a foamite extinguisher system. The warehouse section measures 144x950 ft with 16 ft overhead clearance and includes the shipping department, woodshop, processing department, government storage, maintenance department, etc. Wide aisles are provided throughout the entire plant to assure for rapid movement of all parts and supplies.

Of the total of more than one million sq ft of factory, approximately 700,000 sq ft. is completely air conditioned. The remaining area takes the leakage from the air conditioned areas and so is semi air-conditioned. Air-conditioning power is supplied by four 650-ton centrifugal compressors.

A total of 125,000 cu ft of air per minute can be supplied. During the winter the air-conditioning system will be used for heating. Separate air conditioning units are provided for the paint shop and office building—to provide proper humidity in the former, and permit use of the latter when the factory is not operating. Electrical service is provided from Dallas, with emergency service available in the factory from three 1,000-watt diesel generating units.

Fluorescent lighting has been designed to provide 26 foot candles of light on the working plane at all points, and 40 foot candles at places where precision work is necessary, as in the machine shop.

Provision has been made for expansion of the present factory to double its size, or 2,000,000 sq ft total if the need should arise. General contract for erection of the Dallas factory was awarded to the James Stewart Co.

Executive reorganization of North American Aviation, Inc., places operating functions of all three plants at Inglewood, Dallas and Kansas City under six "functional" managers, each of whom will have charge of all three plants for his particular function, will report direct to President J. H. Kindelberger, Vice President J. L. Atwood. Six functionaries are: R. H. Rice, chief engineer; J. S. Smithson, works manager; L. R. Taylor, director of industrial relations; R. A. Lambeth, treasurer; R. E. Dawe, director of inspection; R. L. Burla, director of public relations and assistant to the president. Staff assistants to the president have been appointed as well: C. I. Gallant, technical consultant; Noble Shropshire, contract administrator; and H. R. Raynor, special assignments. The Inglewood office will continue to be central headquarters for all three plants.

Window Shopping

Handbook of Welded Steel Tubing—Furnishes full information on standard sizes and properties of welded tubing, numerous illustrations and table on critical speeds of welded tubular propeller shafts. Eighty-six pages, price $1. Formed Steel Tube Inst., Cleveland, Ohio.

Carboloy Catalog (GT-129)—Complete expanded tool line covered containing specifications and prices of all sizes. Photos and dimensional drawings of tools accompany tables. Carboloy Co., Inc., Detroit, Mich.

Paint Progress—Information for the paint minded concerned with national defense painting, aircraft camouflage, etc. Vol. 2, No. 2. The New Jersey Zinc Co., New York, N. Y.

Oxy-Acetylene Tips—April 1941, issue containing Part II of "How to Weld 18-8 Stainless Steel" and other features of interest to welders. The Linde Air Products Co., 30 E. 42d St., New York, N. Y.

DeVilbiss Catalog "CJ"—Complete, concise descriptions of air compressor equipment. DeVilbiss Co., 300 Phillips Ave., Toledo, Ohio.

Jessop Mogul—New 12-page booklet describing Jessop's Mogul molybdenum tungsten high speed steel and its advantages over 18-4-1 high speed steels. Jessop Steel Co., 613 Green St., Washington, Pa.

Ex-Cell-O Tool Tips—Men and machines shown under actual working conditions. Ex-Cell-O Corp., Detroit, Mich.

Hycar—Illustrated 8-page booklet on a new group of synthetic rubbers, written in non-technical language and sponsored by B. F. Goodrich Co. The Hydrocarbon Chemical & Rubber Co., 335 So. Main St., Akron, Ohio.

Aviation Uniforms—Illustrated catalog of uniforms, caps, badges, buttons and identification wristlets. Russell Uniform Co., 1600 Broadway, New York, N. Y.

"How to Select Control for D-C Motors"—Featuring a selector chart, this publication offers simple explanations which should be particularly helpful to all concerned with d-c motors. General Electric, Schenectady, N. Y.

Polyvinyl Acetates—A new Bulletin discussing the applications of such thermoplastic resins to needs of various industries. E. I. du Pont de Nemours & Company, Wilmington, Delaware.

General Electric Weld Recorder—Bulletin CR7503-G—Describes a recorder developed primarily to help control aircraft spot welding. General Electric, Schenectady, N. Y.

Horsepower Requirements for Cutting Steel With Kennametal—A hardy varnished paperboard wall chart to enable the tool supervisor to advise the machine operator what depth and feed to use in cutting steel with Kennametal tools. McKenna Metals Co., 217 Lloyd Ave., Latrobe, Pa.

The Lincoln Weldirectory—Illustrated catalog of all Lincoln welding equipment and applications. The Lincoln Electric Company, Cleveland, Ohio.

The Lycoming Star—Devoted to news of Lycoming aircraft engines. Lycoming Division, Aviation Manufacturing Corporation, Williamsport, Penna.

Aviation Cleaning Handbook—A 24-page book describing cleaning methods in use in the maintenance of aircraft, airports, engine shops, etc. Magnus Chemical Company, Inc., Garwood, New Jersey.

Kennametal Price List No. 5—Covers steel and metal cutting tools and blanks. McKenna Metals Company, Latrobe, Penna.

Micro Switch—Index Chart of Stock Micro Switches. Micro Switch Corporation, Freeport, Illinois.

Monsanto Aircraft Finishes—No. 1388—Full list of the Monsanto line of aircraft finishes, Army-Navy finish specification, finishing procedures, upkeep and cleaning of finished surfaces. Monsanto Chemical Company, St. Louis, Missouri.

Page Shaped Wire—Lists large range of special wire shapes available and gives useful information on grade, temper and finishes. Page Steel and Wire Division, American Chain & Cable Company, Inc., Monessen, Penna.

Spot Welder Data—A 4-pg. folder containing information on Ann spot welders. Pier Equipment Manufacturing Co., Milton & Cross Sts., Benton Harbor, Mich.

Machinists Tools—A four page folder of machinist hand tools. George Scherr Co., Inc., 128 Lafayette St., New York, N. Y.

Simplex Jacks—Pocket size manual describing more than 300 sizes and types of Simplex jacks as used in aircraft and other industries. Catalog No. 48. Templeton, Kenly & Co., 1018 S. Central Ave., Chicago, Ill.

S K F Spherical Roller Bearings—A 36-page catalog of roller bearings and their industrial applications. S K F Industries, Inc., Philadelphia, Penn.

Cold-Drawn Seamless Steel Tubing—An illustrated booklet describing applications of Summerill tubing to hydraulic lines and other uses. Summerill Tubing Co., Bridgeport, Montgomery County, Penna.

Syncrogear Bulletin—Describes a new line of double and triple reduction geared electric motors of up to 30 hp. size. U. S. Electrical Motors, Inc., Dept. 137, 80 34th St., Brooklyn, N. Y.

U. S. Steel News—Regular publication devoted to applications of steel in industry. United States Steel Corporation of Delaware, 436 Seventh Ave., Pittsburgh, Penna.

New Machine Tools—Catalog G-O—A 52-pg. illustrated catalog of the complete line of Walker-Turner machine tools. Walker-Turner Company, Inc., Plainfield, N. J.

The Birdmen's Perch

We've always followed the rule that the reader's wish is our command. So—what would you fellows think about making the puzzles and problems on this page a little tougher? Let us know how you feel—and let us have what you consider tough problems, about aviation if possible. Thanks!

Major Al Williams, alias "Tattered Wing Tips,"
Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

FUNNYBONER DEPT.

R. Ralph H. Lewis down at Stetson University in DeLand, Fla. lets down his hair and tells this one on himself:

"My instructor ordered me to take off and go up to three thousand feet. When we got to three thousand he hollered into the one-way phone, "O.K., spin two turns to the right!"

That's when I began to worry, because I had never spun a plane in my life. And apparently the instructor had forgotten that he had never given me any instruction in spins. Then in a flash, I remembered a correspondence course I had taken several years ago, and I recalled what it said about how to do spins and recover.

So—with my heart gripped somewhat loosely between my teeth—I closed the throttle, eased back on the stick and kicked right rudder. Around and around we went! Finally I decided it was time to quit so I neutralized the controls and eased back on the stick. I then heard my instructor say in the phone, "That was good—you made a perfect two-turn spin and came out right on the nose!"

But when we landed and I told my instructor about his slight oversight, it was his turn to swallow his heart and grab a strut for support!

THIS MONTH'S BRAIN TWISTER

Five pilots owning very fast ships decided to determine the speed champion among them. If every pilot raced every other pilot, how many races would take place?

SMOKE WON'T GET IN YOUR EYES!

There used to be a time when St. Louis, Mo., was known as one of the smokiest, dirtiest cities in the country. On a rainy day, they had to keep the street lamps on at high noon in order to see! But all that's changed now.

The City Fathers got together with some experts and worked out new kinds of smokestacks and fuels that would eliminate the soot. And today St. Louis is as bright and clean and dirt free as any city in the country.

The extra trouble St. Louis went to, in eliminating dirt, reminds us of the Gulf engineers. For they weren't satisfied to leave "well enough" alone. They made it their business to apply a new, different process to make Gulfpride purer and freer from impurities. This Alchlor Process, as we call it, actually eliminates up to 20% more of the carbon and sludge formers that can make the operation of an engine costly and inefficient.

That's why you'll find smart pilots, both amateur and professional, protecting their motors with Gulfpride—the oil that's been "cleaned up" to give you longer engine life and better all round operation.

THIS MONTH'S WHOPPER

Dear Major:

I have a number of racing pigeons and every week I have them released at various points ranging from 250 to 300 miles away from their loft. Well, a short time ago these pigeons were released from an airport in Virginia and all but one took off and circled in the conventional manner. But this bird decided to have a drink before starting for the loft and walked over to the bucket used by the mechanics for washing the grease off the airplane parts.

The homing pigeon drank some of the water spiked with G.A.G. and with a sound resembling a rocket took off—but in the wrong direction! I thought I would never see this bird again, but when I got back to the loft I found that all the pigeons had returned and was amazed to learn that the one that had drunk the G.A.G. had got back first!

I investigated further and learned that this bird had been seen out over the Atlantic Ocean, had almost been shot down over Europe, was once sighted over Australia and then was not seen again until he returned to the U.S.

I am now training all my birds on G.A.G. but find it so strong for man, bird or plane that I have to dilute it with 10,000 parts of water!

"The Flying Dutchman"
Duncannon, Pa.

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF AVIATION PRODUCTS

Micro Switches Add To The Dependability of the Curtiss-Wright "Tell-Tale" System

Here is what Micro Switches are used for in the Curtiss Wright "Tell-Tale" System:

Propeller Governor	4 Micro Switches
Throttle	2 Micro Switches
Cowl flap	2 Micro Switches
Tail Wheel Lock	1 Micro Switch
Parking Brake	1 Micro Switch
Mixture Control	4 Micro Switches
Automatic Pilot Centralizer	6 Micro Switches
Carburetor Heat	2 Micro Switches
Impeller Ratio	2 Micro Switches
Tab Controls	3 Micro Switches
Flap	2 Micro Switches
Landing Gear Latch	8 Micro Switches
Hydraulic 4 Way Valve	2 Micro Switches
Tail Wheel Latch	1 Micro Switch
Total	40 Micro Switches

The New Thirty-Six passenger Curtiss-Wright Transport is equipped with 40 Micro Switches

FORTY precision switches used in the Curtiss-Wright "Tell-Tale" System must perform with unerring precision and fidelity under *every* operating condition. After careful tests, Curtiss-Wright engineers selected Micro Switches for this responsible task—convinced that their precision snap-action could be depended on to perform unfailingly for millions of operations under every vicissitude of weather, temperature, vibration and shock to which they might be exposed.

Micro Switches are available in many types specially designed for use in aircraft. In addition to dependability, they have exceptionally light weight and small size—features of special value in aircraft applications. Your letter will promptly bring full engineering data and information on these models.

PANEL MOUNT—for manual or mechanical operation. Size 1⁹⁄₁₆" x 1⅛" x ½". Weight 1.5 oz.

MICRO AIR SWITCH HOUSING—Size 3⁹⁄₁₆" x 2¼" x 1". Weight 4.9 oz.

ARMY TYPE—Size 2⅞" x 1⁹⁄₁₆" x 1⅛". Weight .16 lb. Air Corps specifications No. 32249

Features:

Designed with careful attention to aircraft operating problems of vibration, shock, altitude, cold and atmospheric conditions.

Operates in any position with positive snap action.

All models except Type Q available in Standard Sensitive and Super Sensitive Types with energy requirements from .004 to .0003 ounce inches, depending on type. Type Q in Super-Sensitive Type only.

Meets 10 G tests.

Contact arrangements may be normally open, normally closed or double throw ... single pole only. Listed by Underwriters Laboratories and rated at 1200 watts up to 600 volts A. C. and ½ h.p. 115-460 volts A. C.

Provided with a variety of actuating mechanisms, mountings, housings and terminals suitable to varied operating requirements.

Aircraft Manufacturers Using Micro Switches:

Barkley Grow, Beech, Bell, Bellanca, Bendix Aviation, Boeing, Brewster, Consolidated, Curtiss Dev, Curtiss Wright, Douglas, Eclipse, Fleetwings, Lockheed, Glen L. Martin, Mercury, North American, Vega, Vought Sikorsky, Vultee, Waco, Eastern Airlines, Northeast Air Lines, Pan American Airways, Trans Canada Air Lines, United Airlines

MICRO SWITCH is the Name of a Particular Product, Not a General Term.

MICRO MS SWITCH

TRADE MARK

Manufactured in FREEPORT, Illinois, by Micro Switch Corporation. Sales Offices: New York, Chicago, Boston

"Consolidated" tells us UNISORB* Flame-Proofed

CONSOLIDATED MODEL No. 28
"Official U. S. Navy Photograph"

is the logical material

For Protection of instruments, air seals on engine cowls, arm rests, crash pads, oil seals, and many miscellaneous uses. *For* Sound absorption work, Kapok Unisorb Flame-proofed Felt meets government specifications and is extremely light weight per square foot—easiest installed. *Top flight felts for top flight aircraft*

FELTERS FELT FUNCTIONS

*Reg. U. S. Pat. Off.

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REPUBLIC'S P-43 flashes through its paces on SHELL 100 OCTANE GASOLINE ... AND AEROSHELL OIL

LIKE a sleek silver bullet slashing through space, the new Republic Fighter P-43 does its stuff—its Pratt & Whitney Twin Wasp Engine roaring, on Shell 100 Octane Fuel The same fuel (produced commercially for the first time by Shell) that has made American military planes unexcelled in performance, speed and flying range.

No wonder those who know flying "go" for Shell Aviation Fuel as well as AeroShell Oil. They know Shell Gasoline gives them quick starting, instant throttle response, long cruising range.

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Proved by experts, Shell Products are preferred by pilots everywhere Is it any wonder airport operators the country over are taking to fast-selling Shell Aviation Products? For more details address Shell Oil Co, Inc, 50 West 50th St, New York, N. Y., or 100 Bush Street, San Francisco, Cal.

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REPUBLIC FIGHTER P-43
Flying Weight—4,155 lbs. Length—28' 5¾" Span—36' 1,200 H P Pratt & Whitney Twin Wasp Engine Fuel—Shell 100 Octane Oil—AeroShell
REPUBLIC Uses Shell Aviation Products Exclusively

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Lee ... *Nationally Famous For*
SMART APPEARANCE
PERFECT COMFORT
LONG WEAR

Exclusive Fabrics!—Exclusive Tailoring Have Made Lee BY FAR America's Favorite Industrial Uniform!

"Easier work—smart appearance—longer wear"—yes, those are the reasons thousands of men buy Lee, America's favorite Uniform, year after year.

Exclusive Lee fabrics in smart colors and weaves such as Agan Jeans and Treg Twills!... Exclusive Lee Tailored Sizes made to fit any man according to his height, weight, size and build!... Features that give extra convenience and comfort! ... All combine to maintain America's national preference for Lee Union-Alls and Lee Color Matched Shirts and Pants.

Whether you're a worker or whether you're the "boss"—you'll want to know Lee's Uniform proposition. Why not fill out the coupon below and send it in?

Genuine Lee Tailored Sizes

A Perfect Fit for Every Build

(Handsome Emblems or Lettering in Full Colors)

New Lee Hinge-Back Works Like a Hinge! Gives Amazing Freedom and Work Comfort — An Exclusive Lee Union-All Feature.

UNION MADE **Lee** *Hinge-Back* **UNION-ALLS** *Color-Matched* **SHIRTS & PANTS**

W4104
Beautiful Weaves in Colors in Agan Jeans and Treg Twills—Exclusive in Lee Uniforms—Sanforized Shrunk (Fabric Shrinkage Less Than 1%)

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THE H. D. LEE MERC. COMPANY Dept A 5
Write Nearest Office
Kansas City, Mo.
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Please send us your proposition for outfitting our crew of ____ men in distinctive Lee Uniforms with embroidered firm insignia.

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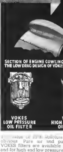
The Seed and the Timber...

FEBRUARY 1908. Two men, fresh come from the frozen lake which has served them as a flying field, are thawing out by a roaring cabin stove Their faces are flushed, partly by elation, partly by the warmth of the room after the icy bite of the winter air outside The younger of the two is scribbling excitedly in a diary, the words tumbling swiftly, impetuously from his pencil **"Today we flew — FLEW! Yes, after all these weary months of work, we have done it. 826 feet in one straight flight! Even now I can hardly believe it......."**

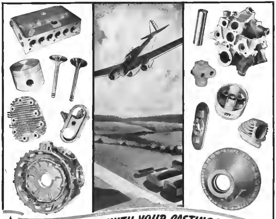
February 1941. Thirty-three years on, and the seed so laboriously planted on that icy February day out on the frozen lake is now broad, strong timber On the tarmac outside the airport buildings a giant streamlined sky-leviathan is waiting to take off Time marches on Thirty-three years It is a short time in which to progress from perilous three-hundred yard hops to regular transcontinental flights, yet even now who can tell how immeasurably far we are from full efficiency in the air? In a hundred years time, maybe, they will be laughing at our efforts Yet in one thing 1941 sees us already possessed of maximum efficiency **That thing is Filtration.** After long months of research, the VOKES laboratories have evolved filters, incorporating **an entirely different principle** of filtration which actually filter down to particles 0 0004 in diameter This is 99 9% efficiency human endeavour can go no further



[illegible] value of [illegible] absolute filtration is obvious Pure air and pure oil (the VOKES filters are available both for air and for high and low pressure oil systems) mean less wear and tear fewer renewals less trouble **greater efficiency** We shall be pleased to answer any enquiries through our agents

VOKES LIMITED · FILTRATION EXPERTS

American and Canadian Agent E Cantin, 101 Park Av , New York



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YOU, who have accepted the almost superhuman task of supplying demands for more, and still more planes, will be glad to know that our four huge, modern plants are undergoing expansion to keep pace with your production schedule.

To help you solve your castings problems, Permite brings more, however, than the physical facilities of four great plants and a pioneering experience in the aluminum alloy field. We offer you in Permite Castings the high quality which results from a choice of correct alloys, distinctive advancements in casting and heat-treating processes, and critical inspection at every step of production.

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PERMITE *Aluminum AND Magnesium ALLOY* CASTINGS

...here are our War Planes? And What is Ahead?
...n appraisal of the first year of air defense production ex-
...nsion. An extension of the program and how the newly
...creased capacity of the aviation industry will be absorbed.

7,000...12,000...or 30,000 Pilots per Year?
The Air Corps is now turning out pilots at the rate of 7,000 a year with expansion stepped up to an expected rate of 12,000 by spring . . . probably stepped up to 30,000. How will it be done?

Expanding the Air Arm for a Two Ocean Navy
About the program of the Bureau of Aeronautics, Navy Department, to train 25,000 new pilots. How island Naval bases will be operated and maintained.

...Planes Must Have Bases
...ow the Army is expanding its operating bases to house 2?? ...quadrons, and how temporary bases are being used in the ...eantime.

Simplifying the Production Job to Use Less Skilled Labor
How Martin breaks down the production operations.

...g Boats and Bombers from the Same Factory
...ow Consolidated turns out PBY's, PB2Y's and B24's.

Everybody Helps Build the Flying Fortress
How to subcontract parts for a big airplane.

...Specification Engineering
...irst of a series on how Lockheed coordinates specifications ...n all work going through the plant.

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Helping to make ten P40's a day.

...ilitary and Commercial Airplanes from the Same Plant
...mmercial production does not interfere with military work

Developing Subcontractors for High Precision Manufacturing
How complicated instruments production is being farmed out

...ow to Finish a Contract Ahead of Schedule in Spite of a Strike

Keeping a Finger on Shadow Plants
How North America is going to run its Dallas and Kansas City factories by remote control.

Airplane Floats in Quantity
Production at the plant of Edo Aircraft.

...ssembly Line Control
...ell Aircraft devises a production line with primary emphasis ...nal assembly.

Production Incentives
What the manufacturer can do to increase the efficiency of individual workers.

Coming in June

AVIATION PRODUCTION NUMBER

SINCE THE BEGINNING of America's air expansion program in 1937, Aviation magazine has kept the industry up to date on the program — advancements in production technique that have increased output a thousand-fold.

Since 1938, Aviation's "Defense Production Number," reviewing progress and the job ahead, has presented the most successful manufacturing methods in use. The men actively in charge of aircraft engineering, design and production have enthusiastically welcomed this constructive effort as one of their most valuable sources of up-to-the-minute working information.

This year's "AVIATION PRODUCTION NUMBER," to be published in June, will be the most complete and valuable in the series. It will recognize that the greatly expanded aviation program demanded by the present emergency calls for the application of the most modern production methods by all manufacturers.

Thus this issue will have added value for the men building aircraft, engines, equipment and materials — and will also offer exceptional advertising effectiveness.

CLOSING DATE FOR COMPLETE PLATES
MAY 13, 1941

THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

AVIATION

330 W. 42d ST., NEW YORK, N. Y.

EXPANDING THE AIR ARM FOR A TWO OCEA... NAVY

BIG BOATS AND BOMBERS FROM THE SAM... FACTORY

EVERYBODY HELPS BUILD THE FLYING FORTRES...

7,000 . . . 12,000 . . . OR 30,000 PILOTS PE... YEAR?

WHERE MANUFACTURING BECOMES PRODUCTION

A COMPLETE LINE FOR DEFENSE

The SERV A PLANE is a complete airport filling station. Dispenses gas, stores canned oil, rewinds hose by power

One of the BOWSER high speed underground fueling pits used for fueling transport planes.

BOWSER

REFUELING SYSTEMS

FUEL DISPENSED FROM BOWSER REFUELING SYSTEMS IS CLEAN—DRY—SAFE!

Since the early days of the airplane, BOWSER has designed and built equipment for quick efficient fueling. Many types and sizes of underground fueling pits—metering systems for trucks—marine type systems—defueling equipment—and other types are available. No matter what your refueling, defueling or lubricating oil equipment needs might be . . . consult BOWSER . . . and you'll find the answer.

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FOR THE AVIATION INDUSTRY BOWSER MAKES . . . .

- Above-Ground Systems
- Underground Systems
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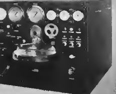
TESTS ALL PROPELLER GOVERNORS *made today*



The Airaco Propeller Governor Test Unit is the only one that will test, calibrate and adjust all types of propeller governors made today. It enables the operator to perform all necessary test functions as recommended by the manufacturers of both Hamilton Standard and Curtiss Electric propeller governors. Write for engineering data sheets giving full particulars.

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by controlling oil temperatures

Military airplanes must fly in all altitudes—in widely varying temperatures. Under these extreme conditions, lube oil temperatures must be maintained within the range required for proper lubrication. The use of the Harrison Oil Cooler and Control Valve makes this control possible.

When the oil is cold, and excessive pressures might damage the cooler core, the thermostatically-operated valve by-passes it back to the engine or the reserve tank. As the temperature rises, gradually increasing quantities of oil are admitted to the cooler, where a new principle of baffling shortens the warm-up period. When the oil reaches the desired temperature, the valve is fully open—and the core is ready to perform its function.

During high-altitude operation, and under high-temperature conditions as well, the Harrison Oil Temperature Regulator constantly maintains proper temperatures of the lubricating oil.

Call on Harrison engineers to discuss with you the results obtained in actual flight tests.

HARRISON AVIATION PRODUCTS

HARRISON RADIATOR DIVISION
GENERAL MOTORS CORPORATION
LOCKPORT, NEW YORK

Before a single ship takes wing...

Precision tools are vitally essential in the production of modern aircraft. As the World's Greatest Toolmakers, The L. S. Starrett Company is making every effort to keep production abreast of unprecedented demand. Enlarged plant capacity, increased personnel, and a day-and-night operating schedule are helping us to do our part for National Defense without sacrificing Starrett standards of accuracy and dependability.

THE L. S. STARRETT CO.
World's Greatest Toolmakers
Precision Tools . . . Dial Indicators . . . Ground Flat Stock
Hacksaws . . . Metal Cutting Bandsaws . . . Steel Tapes
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Standardize on **STARRETT TOOLS** BUY THROUGH YOUR DISTRIBUTOR

for DEFENSE against DIRT

KEEP IT CLEAN with PUROLATOR

IN THE PLANT

Purolator lube oil filters are now widely used to guard against the dangers of dirty oil in block tests of aviation engines Purolator meets this problem with the experience gained in producing a great majority of the filter equipment used on gasoline and Diesel engines of all kinds.

IN THE 'PLANE

Another important Purolator development is a thoroughly dependable filter for the hydraulic systems now installed in practically all of the planes using retractable landing gear wing flaps, and other mechanisms used in the armament of Army and Navy fighters The G-159J Purolator illustrated will handle 12 g p m of 100 SSU oil at 100°F with a minimum of 12# pressure drop Operating pressures are up to 1500# Weight of this unit is one pound four ounces

PUROLATOR Oil Filters

PUROLATOR PRODUCTS INC. NEWARK NEW JERSEY

IMPORTANT SAFETY NOTICE

Landings and take-offs are safer when tire pressures are balanced and the tire valves sealed with air-tight caps Standard tire valve caps seal the tire valve mouth and are guaranteed to hold air up to 250 lbs pressure After tire pressures have been balanced, always replace the air sealing valve caps. A Schrader's Son Division of Scoville Manufacturing Company, Inc., Brooklyn, N. Y

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Do in MINUTES jobs which otherwise require HOURS!

Conservatively estimated TANNEWITZ DI-SAWS save an average of 70% of the time and cost involved in making inside and outside cuts on dies, shoes, templates and hundreds of other operations, including filing and polishing, to which these machines are ideally adaptable. In many instances they are turning out work in as little as ONE-TENTH of the former time required.

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The popularity of DI-SAWING is growing by leaps and bounds. Get the complete facts on the most highly developed DI-SAW on the market Simply write for our DI-SAW Bulletin.

Made by Sawing Machinery Specialists

SAWING SPEEDS PER MINUTE

THICKNESS	CAST IRON	COLD ROLLED	TOOL STEEL	HI SPEED STEEL	HI CHROME HI CARBON
¼"	16"	9"	5"	2½"	1½"
½"	8"	4½"	2½"	1¼"	¾"
1"	3½"	2¼"	1¼"	½"	⅜"
1½"	2"	1"	⅜"	5/16	3/16"
3"	1"	½"	5/16"	5/32"	3/32"
6"	½"	⅛"	5/32"	5/64"	1/32"

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.

Solar builds for Super power

The heat and corrosion resistant manifold came into being as a result of **SOLAR'S** experiments on 450 horsepower engines in U. S. Navy fighters

These early developments led the way to present day design and construction of exhaust systems to hold horsepower ratings from one to two thousand.

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ESTABLISHED 1927

Solar Aircraft Company

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Type AVIO-D Fuel and Oil Line Hose
C.A.A. Approved

Avioflex Hose is oil-proofed with cellulose—a material completely resistant to action of hot oils and high test gasolines.

Sizes (I D) 3/16" to 1½". Pressures to 2600 p.s.i.

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Type CL-N Hydraulic Hose
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Cellu-lined Hose is the equivalent of Avioflex in qualities and construction, with additional strength obtained by imbedding the metal braid in the synthetic casing.

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***COUPLINGS** for Avioflex are readily attachable in your own plant, or, like Cellu-seal couplings, are factory assembled.*

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MAYWOOD, ILLINOIS

Write for Data and Engineering Recommendations on Specific Problems Involving Flexible Connections

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"For Aircraft Auxiliary Service"

**COMPACT
LIGHTWEIGHT
DEPENDABLE**

*1500 to 6500 Watts
124 to 225 Pounds
Alternating or Direct Current*

★

ONAN OT SERIES ELECTRIC PLANTS are Lightweight, Heavy Duty units capable of furnishing ample Power for operation of everything electrical aboard the Plane, Radio Broadcasting and Receiving Equipment, Lights, Landing Gears, Telephonic Communication Systems and All Appliances. ONAN PLANTS can be furnished in Manual, Full Automatic or Self Starting Models. Any Voltage—Any Frequency—Battery or Non-Battery charging Types.

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WILKES-BARRE, PENNSYLVANIA

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Top quality aluminum alloys are produced in our modern laboratory-controlled foundry. We machine pistons to exacting specifications on up-to-date equipment

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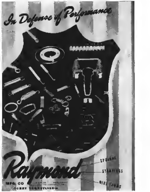
Detroit, Michigan



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BOWLUS ALBATROSS SAILPLANE Fully equipped single place sailplane part rebuilt at factory complete with trailer Instruments include Variometer, compass, airspeed altimeter and bank indicator. Price $300.00 Horace Tenney VF6, Naval Air Station, San Diego, California.

Cub

CUB J2. One wing and fuselage must be recovered Petere relicensed. Heat has always passed inspection. Cash $400.00 M. Barr, Boyle, Mississippi.

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50 H P CULVER Cadet Demonstrator low hours Franklin Motor, starter, generator, Battery, navigation lights Burnham Freedmen propeller and two tone color. Culver, 68 Post St, San Francisco, Calif.

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FLAMINGO All metal. Wasp SC 1 450 H place, 6 seats removed. Recently refurbished relicensed Well equipped. Cruises 120 mph Range 7 hours Payload 1393 pounds $2500 cash. 133 hours since major. Also extra motor just majored $925 Hoeie Zacherle Register and Tribune Employees Credit Union, Register and Tribune Building, Des Moines, Iowa

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LOCKHEED VEGA Wasp SC 1 450, 7 place. Recently rebuilt, relicensed Fully equipped Cruises 165 mph Range 8 hours. Payload 1000 pounds $4900 cash 78 hours since major. Also extra motor just majored—$925 Hoeie Zacherle Register and Tribune Employees Credit Union, Register and Tribune Building, Des Moines, Iowa

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LUSCOMBE 1940 65 continental dual ignition Like new, 100 hours total time. Always hangered, never damaged. Forced to sell. Best reasonable offer. Earl Mesool, Reese, Mich

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STINSON 105 Continental 75A Built in January '40 Yellow with vermillion striping. Uses 73 Octane. All extras. Kollsman directional compass vertical speed, sensitive altimeter Fishest air speed, turn bank, Lear receiver with rotatable loop. Flown 175 hours by owner only. Relicensed to December 1941. Price $2,650 cash James R. Mock, 1266 Penobscot Bldg Detroit Mich

Taylorcraft

1940 Deluxe TAYLORCRAFT 65 Lycoming. 125 hours total. Brakes, tailwheel, parking brake, radio compass $1400.00. Lihme, Roosevelt Field, N Y

INDEX

AVIATION "Classified" — May, 1941

Undisplayed ads offering only ONE make of plane are grouped under that make Others appear under USED PLANES—General and are numbered and indexed to enable readers to conveniently locate the maker of planes offered, in either layout of interest. All other undisplayed and displayed ads—excepting those relating to employment and business opportunities—are numbered, or referred to by number and indexed for the reader's convenience in quickly finding ads

Taylorcraft

TAYLORCRAFT 1938 A 40 4 Always privately owned. Compass Fank and turn indicator, Brakes and tailwheel. Total 275 hours. Always hangared excellent condition $750 M Keller, 65 Central Park Avenue, Yonkers, New York.

Used Planes—General

(See index on this page)
(See also Group Classifications)

Sparton "Executive" special equipment, total time less than 300 hours. Fairchild Warner, total time 360 hours, time since last engine overhaul 150 hours 2-way radio, gyro compass fuel capacity 60 gallons, with wheels and floats Inquire Westchester Airplane Sales Co., Inc. 292 Madison Ave., N Y C Phone: Lexington-2-6360. No. 1

Engines & Parts

See also ads marked (P) in group Classifications

AMERICAN CIRRUS and Wright Gypsy Partal Complete Stock of Brand New Cirrus and Gypsy Parts at 50% Discount. Write Menasco Manufacturing Company, 6927 McKinley Avenue, Los Angeles, California. No 2

One 350 hp Jacobs engine manufactured 1940 shielded together with constant speed propeller and fuel analyzer. Total time 125 hours, no time since factory top and installation of new type pistons. Details and price on request. Wings Field, Inc., Ambler, Pa. No 3

Equipment & Products

Aircraft Batteries

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Cylinder Baking Oven

CYLINDER BAKING OVEN Low cost Automatic time clock. Low wattage Electrically operated Complete $39.98 Aeronautical Trading Co, Floyd Bennet Airport, Brooklyn, N Y. No. 5

Miscellaneous

School Equipment metal wings Wasp engines Curtiss Electric propeller $150 constant speed $95 Pesco fuel pumps Hydraulic motors selector valves retractable gears list free Marvin Northrop Aeroplane Co. Minneapolis Minnesota No. 6

Parachutes

Parachutes bought, sold, serviced erected. New York Distributor for Irvin Air Chute Have several used Irvin Quick Connectors at reasonable prices Joe Crane, Roosevelt Field, Mineola, L. I., N. Y. No. 7

Services & Instruction

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DON'T FAIL! Test yourself Pilot's Text C.A.R., Meterology, Navigation, (multiple choice) $1.00 Mechanic's Text, Airplane Engines Instruments (written) $1.00 Question-Air System, 208 East 34th, Austin Texas. No. 8

QUALIFY AS AIRPLANE & ENGINE Mechanic during peak demand 1941 texts prepare you for government rating (license) exams Includes all diagrams, procedure civil air regulations. Author holds A & E Certificate plus B S in Aeronautical Engineering. Airplane text $1.25, Engine text $1.25 Combination $2.00 Postpaid or C O D Flight Press, Box 224V, Champaign, Illinois (No. 9)

GIVE YOURSELF A BREAK... DON'T BREAK YOURSELF!

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AMERICAN, 38, British education, experienced, Aviation, final assembler, consider experimental tools. Reader Aeronautics, travel conscientious Millet, 113 E 168th St, Bronx N Y.

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For permanent positions as follows:

Young Mechanical Engineer, experienced in design and development of air-cooled engines by single-cylinder methods

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Experienced aircraft engine Draftsman, capable as a squad leader for group of junior draftsmen

Apply giving complete experience record proving ability, stating salary expected

P-639, Aviation 330 W 42 St. N Y C

TECHNICAL SALESMAN AVAILABLE

June 1st Now traveling Northwest States for large manufacturer of a technical product but due to decline of entire industry seeking mountable sales position Age 35, married financially responsible and free to travel A past record of successful selling. Please write for detailed application

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Building Suitable For Sub-Contract Manufacturing or Sub-Assembly

STEEL AND BRICK BUILDING, Modern one-story, containing approximately 28 000 sq. ft. of floor space Building is well lighted and equipped with two 3-ton and two 5-ton floor-operated cranes. Separate service building equipped with washroom and toilet facilities and an office building with an area of 2 400 sq ft. Parking space nearby. Shipping facilities include spur track into main building arranged for car floor level loading. All contained on about $1\frac{3}{4}$ acres, approximately 75 000 square feet of land. Houston, Texas.

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STANDARD AVIATION, Inc.
Bendix Airport, Bendix, N. J.
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Scarab

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AERONAUTICAL ENGINEERING — GROUND — MECHANICS — FLYING — INSTRUMENT

(Continued on opposite page)

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HORNET	525 H.P.	WARP	480 H.P.
HISPANO 180	220 H.P.	I 8 9	330 H.P.
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AVIATION SCHOOLS

AERONAUTICAL ENGINEERING — GROUND — MECHANICS — FLYING — INSTRUMENT

(Continued on opposite page)

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City ______ State ______

See School Advertising Index on Page 211 for additional Schools and Flying instructions

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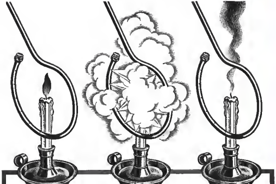
SCHOOLS

AVIATION'S MARKET PLACE

(CLASSIFIED ADVERTISING)

(CLASSIFIED DISPLAY ADVERTISING)



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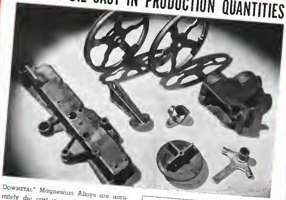

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